STRUCTURAL MANUAL

Ministry of Transportation
Provincial Highways Management Division
Highway Standards Branch
Bridge Office
September, 2016

ISBN 978-1-4606-8646-1

REVISIONS TO THE STRUCTURAL MANUAL

This Structural Manual dated **September 2016** includes **Revision #58** and supersedes the previous edition. Changes from previous edition are summarised as follows.

Major revisions to Divisions 1 and 2

Exceptions to the CHBDC

This section has been updated for CHBDC-2014

Part 1

- Section 1.1.2 AADT definition added
- Section 1.1.6 updated

Part 2

- Section 2.1.1 updated
- Section 2.1.3 updated
- New Section 2.1.6 added
- Section 2.8.2 updated
- Table 2.8.2 updated and moved to Section 12 to become Table 12.1.3
- Figure 2.8.2 moved to Section 12 to become Figure 12.1.3(d)
- New Section 2.8.3 added

Part 3

- Section 3.1.2 last paragraph deleted
- Section 3.2.1 third paragraph updated
- Section 3.2.2 updated
- Section 3.3.1 note no. 7 updated

Part 5

- Section 5.3.1 third paragraph updated

Part 6

- Section 6.3.1 second & third paragraphs updated
- Figures 6.3.1(a) and 6.3.1(b) updated
- New Section 6.3.3 added

Part 7

- Section 7.2.1 bullets (e) & (h) updated
- Section 7.2.7 first and last paragraphs updated
- Section 7.3.1(j) updated

Part 8

- Section 8.1.1(h) updated
- Section 8.1.1(p) updated
- Section 8.1.2 2nd and 3rd paragraphs updated
- New Section 8.1.3 added

- Section 8.3.3 changed to 8.3.3(a), 1st paragraph updated
- Section 8.3.4 changed to 8.3.3(b)
- Section 8.3.5 changed to 8.3.3(c)
- Section 8.3.4 – new content and new figure
- Section 8.3.6, 8.3.7 and 8.3.8 renumbered to 8.3.5, 8.3.6 and 8.3.7
- Section 8.6.2 updated
- Section 8.7.1 1st paragraph updated
- Section 8.7.2 3rd paragraph updated
- Section 8.7.8 updated
- Figure 8.7.8 updated
- Section 8.8.2 General Notes no.1, 8 and 12 updated
- Section 8.8.2 note no.16 added

Part 9

- New Section 9.10.1 added

Part 10

- In general, Performance Level 1, 2 and 3 (PL-1, PL-2, PL-3) are changed to Test Level 2, 4 and 5 (TL-2, TL-4, TL-5)
- Section 10.1.2 definition for $AADT_1$ added
- Section 10.1.3 (1) 1st paragraph deleted
- Section 10.1.3 (1) (d) deleted & Figure 10.1.3.1(d) deleted
- Section 10.1.3 (2) 1st paragraph deleted
- Section 10.1.3 (2) (a) 2nd paragraph updated
- Section 10.1.3 (2) (c) 1st & 2nd paragraphs updated
- Figure 10.1.3.2(c) deleted & Figure 10.1.3.2(d) changed to Figure 10.1.3.2(c1)
- Figure 10.1.3.2(c2) added
- Figure 10.1.3.2(e) changed to Figure 10.1.3.2(d)
- Section 10.1.3 (3) 1st paragraph deleted, 1 new paragraph added
- Section 10.1.3 (3) (a) 3rd paragraph deleted
- Section 10.1.4 updated
- Section 10.1.6 updated
- New Section 10.1.7 added
- Section 10.3.2 updated

Part 12

- Section 12.1.1 updated
- Section 12.1.3 updated
- New Table 12.1.3 added (moved from Table 2.8.2)
- Figures 12.1.3(a) & 12.1.3(b) updated
- New Figure 12.1.3(d) added (moved from Figure 2.8.2)
- Section 12.5.2 note no. 4 added
- Section 12.5.4 updated

Part 13

- Section 13.1.1 updated
- Section 13.1.4, updated, heading changed
- Section 13.1.5 updated
- Section 13.2.2 bullet 3 updated

- Section 13.3.3 updated
- Section 13.3.4 updated
- Section 13.3.9 table footnotes updated
- Section 13.4.1 updated, table updated
- Section 13.4.2 updated , heading changed
- Section 13.4.3 updated , heading changed
- Section 13.4.4 updated , heading changed
- Section 13.4.5 updated , heading changed
- Section 13.4.6 updated , heading changed
- Section 13.4.7 updated , heading changed
- Section 13.4.8 updated , heading changed

Part 14

- Section 14.1.3 last paragraph deleted

Part 16

- Section 16.7.1 updated
- Section 16.7.2 OPSD 2456.010 in 2nd paragraph deleted
- Section 16.10.1(2) updated

Part 17

- Section 17.1.1 updated

Part 18

- Section 18.1.1 bullet (b) updated

Division 3

Sheet DA12-2 removed

Division 4

Drawings listed below released after Revision #57 are inserted.

SS110-37	SS110-38	SS110-39	SS110-82	SS110-83	SS110-84
SS110-85	SS113-19	SS113-37			

Drawings listed below are replaced with the version currently available in CPS.

SS10-21	SS10-40A	SS10-40B	SS10-40C	SS10-42A	SS10-42B
SS10-43A	SS10-43B	SS12-1			
SS107-1	SS107-2	SS107-3	SS107-4	SS107-5	SS107-6
SS107-11	SS107-12	SS107-13	SS107-14	SS107-15	SS107-16
SS107-17	SS107-18	SS107-19	SS107-20	SS107-21	SS107-22
SS107-23	SS107-24				
SS109-40	SS109-41				
SS110-21	SS110-44	SS110-45	SS110-46	SS110-47	SS110-48
SS110-49	SS110-54	SS110-56	SS110-57	SS110-58	SS110-59
SS110-61	SS110-62	SS110-63	SS110-64	SS110-65	SS110-66
SS110-68	SS110-69	SS110-70	SS110-71	SS110-72	SS110-73
SS110-74	SS110-75	SS110-80	SS110-81	SS110-90	SS110-91
SS110-92	SS110-93	SS110-95	SS110-96	SS110-97	SS110-98
SS110-104	SS110-105	SS110-106	SS110-109		
SS113-10	SS113-11	SS113-12	SS113-15	SS113-16	SS113-17
SS113-18	SS113-20	SS113-30	SS113-31	SS113-32	SS113-34
SS113-35	SS113-36				
SS116-1					

Drawings listed below are removed.

SS10-50A	SS10-50B	SS10-50C	SS110-40	SS110-41	SS110-42
SS110-43	SS110-107	SS110-108			

To all users of the: **STRUCTURAL MANUAL**

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The Structural Manual was first developed by the Structural Office in the 1970's to provide a convenient reference for procedures, policies, design provisions, design aids, and structural standard drawings that were to be used in the preparation of Ministry structural contract documents. Subsequently the manual has been continuously updated to reflect changes due to metrication, new bridge codes and current practices. Since its inception the Structural Manual has been revised to be compatible with the AASHTO code, OHBDC, and now with this edition the CHBDC. To accommodate the growth in bridge engineering knowledge the Structural Manual will continue to be revised by the Bridge Office when appropriate.

The current manual is divided into the following four divisions:

Division 1 - Exceptions to the Canadian Highway Bridge Design Code
Division 2 - Procedures
Division 3 - Design Aids
Division 4 - Structural Standard Drawings - Section 1
Structural Standard Drawings - Section 2

Previous manuals only had the divisions 2 to 4. A Table of Content or a List precedes each division as appropriate.

Although the Ministry of Transportation has developed this manual as a standard for their use, other bridge owners may use it as a resource document from which they can develop their own standards and policies. However, any variation should not be a substantial departure from the Structural Manual or cause an adverse affect on the safety and movement of people and goods. Any deviation from this manual should be based on operational experience and objective analysis. The Ministry of Transportation does not accept responsibility in any connection with the variations.

Suggestions for the improvement of this manual, or for the addition of new material, should be forwarded to:

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2nd Floor
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DIVISION 3 - DESIGN AIDS

DIVISION 4 - STRUCTURAL STANDARD DRAWINGS

SECTION 1

SECTION 2

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highways and Transportation Officials
ACR	Atmospheric Corrosion Resistant
AREMA	American Railway Engineering & Maintenance of Way Association
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
BBR	Canadian BBR Inc.
BDIMS	Bridge Document Imaging Management System
CDED	Contract Design, Estimating and Documentation
CHBDC	Canadian Highway Bridge Design Code
CPCI	Canadian Prestressed Concrete Institute
CPS	Contract Preparation System
CSA	Canadian Standards Association International
DA	Design Aids
DD	Design Details
DOT	Department of Transportation
DSM	Designated Sources for Materials
DSM	Designated Sources Material
DYWIDAG	DYWIDAG Systems International Canada Ltd.
ERT	Effective Rubber Thickness
FHWA	Federal Highway Administration
GFRP	Glass Fibre Reinforced Polymer
HPC	High Performance Concrete
HSS	Hollow Structural Section
HWL	High Water Level
kN	kilo Newton

m	metre
MASH	Manual for Assessing Safety Hardware
mm	millimetre
MPa	Mega Pascals
NCHRP	National Cooperative Highway Research Program
NSSP	Non-Standard Special Provision
NTS	Not to Scale
NWPA	Navigable Waterways Protection Act
OHBDC	Ontario Highway Bridge Design Code
OPSD	Ontario Provincial Standard Drawing
OPSS	Ontario Provincial Standard Specifications
PI	Point of Intersection
RSS	Retained Soil System
SC	Spiral to Curve
SLS	Serviceability Limit States
SS	Structural Standard
TC	Tangent to Curve
TL	Test Level
TFE	Polytetrafluoroethylene Polymer
TM	Temporary Modular
TMB	Temporary Modular Bridge
TTI	Texas Transportation Institute
ULS	Ultimate Limit States
VSL	VSL Canada Ltd.
WP	Work Project/Working Point

STRUCTURAL MANUAL

DIVISION 1 – EXCEPTIONS TO THE
CANADIAN HIGHWAY BRIDGE DESIGN CODE

September, 2016

1.0 SCOPE

These exceptions implement provisions that CSA-S6-14, Canadian Highway Bridge Design Code (CHBDC) and Commentary delegates to the Regulatory Authority for highway structures in Ontario. They also set forth design criteria that are exceptions to those included in the CHBDC. These exceptions may be in the form of deletions from, additions to, or modifications of the CHBDC. All owners must always use these two documents jointly in order to prepare contract plans and specifications for structural elements and/or systems on Ontario highways. Such elements and/or systems include, but are not limited to, bridges, overhead sign structures, earth retaining structures, buried structures and miscellaneous roadway appurtenances.

Exceptions for low volume roads are to be found in Appendix A. In the event of any inconsistency or conflict in its contents and the exceptions given in Section 4.0 below, the appendix will take precedence and govern.

2.0 AUTHORITY

Amendment to Ontario Regulation 104/97 made under the Public Transportation and Highway Improvement Act. (*PTHIA*)

3.0 IMPLEMENTATION

Immediately for all designs according to CHBDC.

4.0 EXCEPTIONS

In the following changes, the relevant CHBDC clause numbers are given next to each provision and the latest version of any standard referred to shall apply.

SECTION 1 - GENERAL

1.3.2 General Administrative Definitions

The following definitions shall apply:

Regulatory Authority — means the person who holds, or is acting in, the position of the Chief Engineer of the Ministry of Transportation of Ontario.

1.4.2.5 Single Load Path Structures

This clause is amended by the addition of the following:

For bridges, a single load path structure shall not be used unless Approved.

1.4.4.5 Plans

The third paragraph is deleted and replaced with the following:

In order to validate and certify the design shown on the plans, the engineer and checker shall each affix his or her Professional Engineers Ontario seal to each and every drawing, and each shall sign and date the appropriate seal.

The following shall be added to the provisions of this clause:

Specifications for construction and rehabilitation shall be in accordance with the *Ontario Provincial Standards for Roads and Public Works* or other Approved standard. In the event of any inconsistency or conflict in the contents of these standards and the CHBDC, the *Ontario Provincial Standards for Roads and Public Works* or other Approved standard will take precedence and govern.

For the Ministry of Transportation, Ontario, the following order of precedence will govern:

a) Ministry approved standards
b) Ontario Provincial Standards for Roads and Public Works
c) CHBDC

1.5 Geometry

In this subsection all references to "...the Regulatory Authority, or in their absence, with the TAC Geometric Design Guide for Canadian Roads." are deleted and replaced by "...the Geometric Design Standards For Ontario Highways or a standard Approved by the Regulatory Authority."

1.6 Barriers

In this subsection all references to "...the Regulatory Authority, or in their absence, with the TAC *Geometric Design Guide for Canadian Roads*." are deleted and replaced by "...the *MTO Roadside Safety Manual* or an Approved standard."

1.9 Hydraulic Design

In this subsection all references to "...the Regulatory Authority, or in their absence, with the TAC *Guide to Bridge Hydraulics*" are deleted and replaced by "...the *Ministry of Transportation*

(MTO) Drainage Management Manual and MTO Highway Drainage Design Standards." Similarly all other references to the TAC *Guide to Bridge Hydraulics* are deleted and replaced by "...the *MTO Drainage Management Manual and MTO Highway Drainage Design Standards*."

1.9.1.2 Normal Design Flood

The first paragraph is deleted and replaced with the following:

The normal design flood in Ontario shall have a return period in accordance with the MTO Highway Drainage Design Standard WC-1, Design Flows (Bridges and Culverts).

1.9.1.3 Check Flood

The first paragraph is deleted and replaced with the following:

The check flood in Ontario shall have a return period in accordance with the MTO Highway Drainage Design Standard WC-1, Design Flows (Bridges and Culverts).

SECTION 3 - LOADS

3.8.3.1.1 CL-W loading

The last three paragraphs are deleted and replaced with the following:

A loading exceeding CL-625 may be specified by the Owner.

3.8.4.3 Local Components

Item (b) is deleted and replaced by the following:

(b) For modular expansion joints, the larger of the following axle loads shall be used:

- Axle no. 4 of the CL-625-ONT truck for ultimate and serviceability limit states and axles 2 and 3 of the CL-625-ONT truck for the fatigue limit state,
- The heaviest axle of the Special Truck(s) specified in Clause 3.8.3.2.1, if applicable.

For structural components other than joint armouring, the horizontal load shall be 20% of the vertical load applied at the roadway surface and considered individually or in combination with vertical loads, whichever produces a greater load effect.

For the FLS, the truck shall be positioned anywhere along the length of the expansion joint, but need not be placed closer than 600 mm to a barrier wall.

The maximum (positive) stress at a given location in the joint shall be calculated from the truck positioned at any location along the length of the expansion joint. The minimum (negative) stress at that same location shall be calculated from the truck positioned at any other location along the length of the expansion joint. The calculated fatigue stress range at each location along the joint shall be the algebraic difference between the maximum and minimum stress above.

The required length of the support bar shall be determined based on an installation temperature of 15° C. Force effects shall be calculated based on factored movements in relation to the joint's articulation relative to its positions at 15° C.

3.8.8 Barrier Loads

This clause is amended by the addition of the following note:

CSA is in the process of updating this clause, in particular the values in the loads table. At the time of issuance of these exceptions, it is expected that these updates will be published in an Errata in early February 2016. Until such time, enquires about the use of the Barrier Loads provisions of S6-14 may be directed to CSA.

SECTION 4 – SEISMIC DESIGN

4.4 Earthquake Effects

This clause is amended by the addition of the following note:

CSA is in the process of updating this subsection, in particular the values of the site coefficients. At the time of issuance of these exceptions, it is expected that these updates will be published in an Errata in early February 2016. Until such time, enquiries about the use of the Seismic Design provisions of S6-14 may be directed to CSA.

SECTION 6 - FOUNDATIONS

6.11.4.5 Degradation of pile foundations

This clause is amended by the addition of the following:

Exposed steel H and steel tube piles shall have an Approved protective coating applied from an elevation 600 mm below the low water level or finished ground surface up to the top of the exposed steel.

6.11.4.9 Splices

The last sentence is deleted and replaced with the following:

Wood piles shall not be spliced.

SECTION 7 - BURIED STRUCTURES

7.1 Scope

This subsection is amended by the addition of the following:

The provisions of this Section apply only to structures that are greater than 3 m in span.

Specifications for construction, rehabilitation and design provisions, where applicable, shall be in accordance with the *Ontario Provincial Standards for Roads and Public Works*.

7.8.8.2.2 Box Sections and Segmental Structures without Stirrups or Ties

The contents of this clause are deleted and replaced with the following:

The shear strength shall be determined in accordance with Section 8, unless Approved.

SECTION 8 – CONCRETE STRUCTURES

8.4.2.1.1 Specification

This clause is amended by the addition of the following:

Other grades of reinforcing bar not covered by CSA G30.18 are only permitted when approved for use by the Ministry of Transportation Ontario (MTO).

8.5.3.1 Reinforcing Bars

The contents of Clause (c) are deleted and replaced with the following:

Unless otherwise Approved, tack welding of reinforcing bars shall not be permitted. If Approved, tack welding shall follow the requirements of CSA W186. For bars containing complete joint penetration groove welds that meet the requirements of CSA W186, the stress range in the vicinity of welds shall not exceed 100 MPa. For other types of welded splices, the stress range shall not exceed 65 MPa.

8.8.4.6 Prestressed concrete stress limitations

The contents of Clause (a)(ii) are deleted and replaced with the following:

(ii) For all prestressed concrete elements, the limiting concrete tensile stress at transfer shall $0.6f_{cri}$.

The contents of Clause (b) are deleted and replaced with the following:

At the serviceability limit states,

(i) Compressive stress in concrete under prestress and permanent dead loads, after allowance for all prestress losses and redistribution of load effects, shall not exceed 0.60f'c.

(ii) The maximum concrete tensile stresses in service shall not exceed 0.5fcr.

(iii) Tension shall not be permitted across the joints of segmental components unless bonded reinforcing bars pass through the joints in the tensile zone.

8.11.2.1 Concrete Quality

The contents of this clause are deleted and replaced with the following:

The minimum concrete strength, maximum water/cement ratio, and the minimum air content requirements for structural concrete shall be as specified in the *Structural Manual* and *Ontario Provincial Standards for Roads and Public Works* or other Approved standard for the appropriate combination of deterioration mechanisms and environmental exposures.

8.11.2.2 Concrete Cover and Tolerances

The concrete cover and tolerance of 50 ± 10 for reinforcing steel in cast-in-place concrete and the concrete cover and tolerance of 45 ± 10 for reinforcing steel in precast concrete shown for component (5) of Table 8.5 (page 343) for "Soffits of Slabs< 300 mm thick " are deleted and both replaced with 40 ± 10.

SECTION 10 – STEEL STRUCTURES

10.6.4.3 Cables, Ropes and Strands

The first paragraph is deleted and replaced with the following:

An Approved method of corrosion protection shall be used for all wires in the cables of suspension bridges, stay cables of cable-stayed bridges, suspension bridge and arch bridge hangers and other ropes or strands.

10.6.5 Other components

The second paragraph is deleted.

10.17.2.2 Design Criteria

The second paragraph is deleted and replaced with the following:

For load-induced fatigue in bridge decks and expansion joints, each detail shall satisfy the requirements that $0.62\ f_{sr} \leq F_{sr}$

A10.1.12 This clause is deleted.

SECTION 11 - JOINTS AND BEARINGS

11.5.1.1 Functional Requirements

This clause is amended by the addition of the following:

The joint shall be accessible for inspection and maintenance and shall be replaceable except for elements permanently attached to the structure.

11.5.1.2 Design Loads

The third paragraph is deleted and replaced with the following:

For armouring of all joints including modular joints, a horizontal load of 60 kN per metre length of the joint shall be applied at the roadway surface, in combination with forces that result from movement of the joint, to produce maximum force effects. Loads for other portions of modular joints shall be as specified in Section 3 of these Exceptions.

11.5.3.1.2 Open Deck Joints

The contents of this clause are deleted and replaced with the following:

Open deck joints shall not be used unless Approved.

11.5.3.2.4 Bolts

The contents of this clause are deleted and replaced with the following:

All anchor bolts for bridging plates, joint seals, and joint anchors shall comprise high-strength bolts fully torqued/tensioned as specified. Cast-in-place anchors shall be used only in new concrete. Expansion anchors shall not be permitted on any joint connection. Countersunk anchor bolts shall not be permitted on any joint connection unless Approved.

11.6.6.4 Deformation and Rotation

The second paragraph is deleted and replaced with the following:

Compressive deformation and rotation requirements are the following:

(a) For laminated elastomeric bearings:

(i) the average compressive deformation of the effective elastomer thickness shall not exceed $0.07h_e$ at SLS.

(ii) where rotation occurs, the bearing shall be proportioned so that, at SLS, there is no uplift at the edge of the bearing and the edge compressive deformation does not exceed $0.14h_e$.

(b) For plain elastomeric bearings:

(i) the average compressive deformation of the elastomer thickness shall not exceed $0.04h_e$ at SLS.

(ii) where rotation occurs, the bearing shall be proportioned so that, at SLS, there is no uplift at the edge of the bearing and the edge compressive deformation does not exceed $0.08h_e$.

11.6.6.5.2 Laminated bearings

The last paragraph is deleted and replaced with the following:

The elastomeric cover on the side surfaces shall be at least 4 mm thick. The elastomeric cover of the outer layers, top and bottom, shall be at least 3 mm and shall not be thicker than 70% of the thickness of an individual internal elastomeric layer.

11.6.6.7 Bearing pressure

The third paragraph is deleted and replaced with the following:

At SLS, the average pressure (MPa) on a layer of elastomer, assuming no rotation, shall not exceed $0.22S^2$. The shape factor shall be based on the thickest layer within the laminated bearing. The shape factor shall not be less than 1.25.

SECTION 12 – BARRIERS AND HIGHWAY ACCESSORY SUPPORTS

12.4.3.3 Geometry and end treatment details

The second footnote (†) of Table 12.8 is deleted.

SECTION 14 – EVALUATION

14.17.1 General

The last sentence of the first paragraph is deleted.

14.17.4.4 Reinforcing Steel

The contents of Table 14.2 in this clause are deleted and replaced with the following:

Table 14.2
Minimum yield strengths of reinforcing steel, MPa

(See Clause 14.7.4.4)

Date of Bridge Construction	Structural Grade	Medium or Intermediate Grade	Hard Grade	Unknown
Before 1914				210
1914-1955	230	275	345	230
1956-1972	230	275	345	275
1973-1978	275	345	415	275
After 1978				
- stirrups and ties	300	350	400	300
- remainder	300	350	400	350

14.12.1 Target Reliability Index

This clause is amended by the addition of the following:

If the bridge is to be re-evaluated within 5 years for Normal Traffic, the Reliability Index, β, specified in Table 14.5, shall be reduced by 0.25. This value shall not be less than 2.5.

14.14.2 Resistance Adjustment Factors

The contents of this clause are deleted and replaced with the following:

For all components, which have no visible sign of defect or deterioration, the factored resistance, as calculated in accordance with Clause 14.14.1, shall be multiplied by a resistance adjustment factor, U. The value of U shall be as specified in Table 14.15, but shall not be taken as less than U = 1.0. Where no value for U is specified in Table 14.15, and in lieu of better information, a value of U = 1.0 may be used.

SECTION 16 - FIBRE REINFORCED STRUCTURES

16.4.4 Cover to reinforcement

The first sentence of this clause is deleted and replaced with the following:

The cover and tolerance for FRP bars and grids shall be the same as the values for reinforcing steel found in Table 8.5 with 10mm subtracted from the cover. The minimum clear cover after consideration of tolerance shall not be less than 30mm.

A. SCOPE

These design guidelines apply for bridges on roads with an average annual daily traffic (AADT), in both directions, of 400 or less. These guidelines may also be used, with Approval, for existing roadways where operational issues such as collisions, traffic delays, etc. are minimal.

B. INTRODUCTION

Present design codes, standards and policies have typically been developed for bridges with high traffic volumes. It has become apparent, however, that for bridges with low traffic volumes these requirements have become too stringent. In order to achieve economies by the relaxing of requirements, and without compromising safety, a task force with MTO Regional and Head Office participation was set up to develop guidelines for this purpose. As a result, this section has been formulated. Where applicable, the CHBDC clause number that is being modified is provided, along with the reference to justify the provision. A commentary is also provided.

Application of these recommendations to bridges on low volume roads will provide an opportunity for savings on structures in these situations. Examples of changes in design criteria that will be effective in achieving this aim are:

- Reduction in minimum soffit clearance over waterways – it was considered that the temporary consequences of possible flooding, including disruption to traffic, were tolerable.
- Reduction in minimum lane and shoulder width – with the lower traffic volumes it is believed that the probability of vehicles encountering or stopping on bridges was not a high risk.

C. DEFINITIONS

Recreational Road	A road used for the access of parks, scenic and historic sites, or seasonal cottages.
Resource Access Road	A road used for mining, forestry and energy development.
Local Road	A road primarily used for land access.
Collector Road	A road providing for land access and traffic circulation.
Arterial Road	A road primarily used for high volumes of through traffic.
AADT	Average annual daily traffic.

TL-0 (formerly LVPL1)	A railing able to successfully redirect a ¾ ton pick-up truck with a speed of 25 km/h and an impact angle of 15°. The level of performance is less than that for TL-1 and is intended for very low volume and low speed traffic.
TL-1	A Test Level 1 (TL-1) is described in CHBDC and satisfies NCHRP Report 350, successfully redirecting a ¾ ton pick-up truck with a speed of 50 km/h and an impact angle of 25˚. The level of performance is intended for low volume traffic at moderate speeds.
CHBDC	CSA-S6-14, Canadian Highway Bridge Design Code

D. CHBDC

The CHBDC should be used for all bridges with the following exemptions allowed for bridges on low volume roads. The relevant CHBDC clause numbers are given next to each provision.

1. GENERAL PROVISIONS	
a) General	**Commentary**
i) The 10 year growth need not be considered for AADT unless a significant change in the road use is foreseen (Cl. 1.5.1).	For these roads, the growth would generally be small.
ii) Some single load path structures such as trusses and 2 girder bridges are acceptable. Alternate load paths may be desirable due to the lack of maintenance that is common on low volume roads (Cl. 1.4.2.5).	This overrides the CHBDC Exceptions and allows their use.
iii) The approach slabs may be omitted. Approach slabs may be beneficial for high abutments to reduce the effects of live load surcharge (Cl. 1.7.2).	These roads are generally lower service roads and settlement would not be a great inconvenience compared to other hazards on the road.

iv) The design life of the bridge shall be 75 years unless reduced at the request of the Owner (Cl. 1.4.2.3).	Certain cases may require a lower life. Consideration should be given to a lower life cycle where alignments are substandard, but improvements are cost prohibitive. In those situations, the owner may not be able to correct the alignments, but may also not wish to be committed to the substandard alignment for 75 years.
v) Reuse of existing bridge materials may be considered at the Owner's discretion. Material condition and physical properties should be determined prior to their use (Cl. 15.8.1.1).	Cost savings from used material may be significant.
vi) Deck drains are only required as given by Clause 1.8.2.3.1. Shorter bridges and bridges with catch basins at the ends of the structure often do not require deck drains.	Traditionally, bridges generally had more drains than required.
b) Geometry	
i) The horizontal and vertical alignment should be determined using roadway design criteria and not the bridge code. Where existing roadway alignments have proven to perform well, then the existing alignment can be used (Cl. 1.5.1).	This allows structure replacement at same location if old structure was adequate.
ii) The use of single lane bridges is acceptable for bridges on some low volume roads. (Cl. 1.5.2) The minimum bridge, lane, and shoulder widths shall be as given in Table 1 (Ref. 2,3). Adequate warning should be given to traffic in the case of narrow or single-lane bridges.	Reduced widths result in lower costs. With AADT less than 200, the probability of 2 vehicles meeting on the bridge is low.

TABLE 1: MINIMUM LANE, SHOULDER AND BRIDGE WIDTHS.

AADT	OPERATING SPEED (km/hr)	MIN. LANE WIDTH (m)	MIN. SHOULDER WIDTH (m)	MIN. BRIDGE WIDTH (m) [1, 4]
0 - 200	< 70	3.0	0.5	4.0 [2,3,4]
	≥ 70	3.0	0.5	7.0
200 – 400 [5]	< 50	3.0	0.5	4.0 [2,3,4,6]
	≥ 50 and < 70	3.0	0.5	7.0
	≥ 70	3.25	1.0	8.5

1 - Width measured between the inside face of the barriers, guiderails, or curbs.
2 - Horizontal and vertical sight distances shall be provided to allow approaching motorists to observe an opposing vehicle on a single lane bridge or its far approach. If there are sight distance issues, a single lane bridge should not be used.
3 - Farm or other special vehicles may require larger widths. Consultation shall be made with local officials. It may also be acceptable to have a lower barrier to accommodate these farm or other special vehicles.
4 - New single lane bridges wider than 4.9 m should be avoided as they may give the appearance of a two-lane bridge.
5 - Range also applies to existing roadways with AADT >400, where operational issues have been minimal and Approval for use of these guidelines has been obtained.
6 - For AADT > 400, or for locations where the Seasonal Average Daily Traffic is significantly >400, consideration should be given to using additional traffic control measures at the bridge for single lane structures (i.e. traffic signals, yield sign for one direction, etc.).

c) Hydrology

i) Hydrologic and Hydraulic design standards shall be as specified in the Highway Drainage Design Standards, January 2008.

ii) Scour and erosion protection is required only for susceptible structures. The stone sizes for scour and erosion protection may be taken from Table 2 instead of RTAC recommendations (Cl. 1.9.9.1) (Ref. 5).

Slightly smaller stones are acceptable.

iii) Slope protection, where required, needs only to be extended 150 mm above HWL (Cl. 1.9.1).

iv) For closed culverts in scour resistant soils, a concrete cut-off wall is not required (Cl. 1.9.5.6).

TABLE 2: REQUIRED STONE SIZE FOR SCOUR AND EROSION PROTECTION

Velocity (m/s)	< 2.0	< 2.6	< 3.0	< 3.5	< 4.0	< 4.7	< 5.2
Nominal Stone Size* (mm)	100	200	300	400	500	800	1000

* - Maximum stone size to be 1½ times the nominal stone size. 80% of stones (by mass) must have diameter of at least 60% of nominal stone size.

2. LOADS	
a) Loads	
i) Lane load need not be considered (Cl. 3.8.3.1.3).	Only 1 truck will be present in the lane.
ii) The bridge can be designed to a load lower than the CHBDC CL-625 truck (Cl. 3.8.3.1.1) provided that the bridge will be properly posted. The live load surcharge can be proportionately decreased with the decrease in truck load (Cl. 6.12.5). Emergency and maintenance vehicle weights should be considered when determining the appropriate design loading.	If properly posted and for specific uses, a lower load limit bridge may be adequate.
iii) The full DLA and load factors should be used (Cl. 3.8.4.5.3).	
b) Limit States	
i) The deflection limit may be reduced to L/360 and need not be checked for temporary modular bridges (Cl. 3.4.4).	A reduced passenger comfort is allowed.
6. FOUNDATIONS	
Bridges designed to a lower live load than the CHBDC CL-625 truck may have the 800 mm live load surcharge reduced proportionately (Cl. 6.12.5).	800 mm surcharge load is calibrated for the full design truck.
8. CONCRETE STRUCTURES	
i) The 10mm allowance for wear on exposed concrete decks may be omitted (Cl. 8.18.3).	
9. WOOD STRUCTURES	
a) Hardwoods may be used and strengths and other properties shall be taken from CSA O86-01 (9.5) (Ref. 10).	This slightly shorter length permits the use of 3½” nails.
b) Transverse nail laminated decks shall have a nail length that pass through two laminates and 10 mm into the third laminate (Cl. 9.21.2.2.1).	Taken from AASHTO and applies to low volume roads where limited traffic means less chance of nails loosening.

c) Longitudinally nail laminated decks can be used and the truck load shall be assumed to be distributed over a width of 1.7 m. (Cl. 9.21.3).	Stressing closes the gap between laminates, minimizing ingress of water.
d) Water borne preservatives may be used for stress laminated timber decks with a minimum dimension of less than 50 mm (Cl. 9.17.12).	
11. JOINTS AND BEARINGS	Joint systems that are used for high volume bridges need not be used for low volume bridges upon Approval by Owner.
12. BARRIERS	
a) A lower performance level is acceptable for some low volume roads (Cl. 12.4.3.2.5) (Ref. 8).	The lower performance barriers can be used on lower speed, low height bridges.
b) A TL-0 and TL-1 railing can be used for bridges meeting the criteria of Table 3. If the criteria of Table 3 are not met then CHBDC must be followed. (Cl. 12.4.3.2.4).	
c) If the bridge has significant pedestrian and bicycle traffic the height of the barrier shall be increased according to Table 12.8 as long as the vehicle barrier interaction is not adversely affected.	
d) Railings that have been successfully crash tested to the above performance limits are given in Figures 1 and 2. Other railings that satisfy the crash test requirements may be used (Cl. 12.4.3.4.2).	These have been used for low volume roads in the United States.

TABLE 3: BARRIER SELECTION CRITERIA

	AADT	Height above water	Operating Speed	Bridge Width
TL-1	≤ 400*	≤ 5.0 m	≤ 50 km/hr	no limit
			≤ 80 km/hr	≤ 5.0 m
TL-0	≤ 100	≤ 2.5 m	≤ 25 km/hr	no limit
			≤ 40 km/hr	≤ 5.0 m

* - Range can be higher for existing roadways where operational issues have been minimal and Approval for use of these guidelines has been obtained.

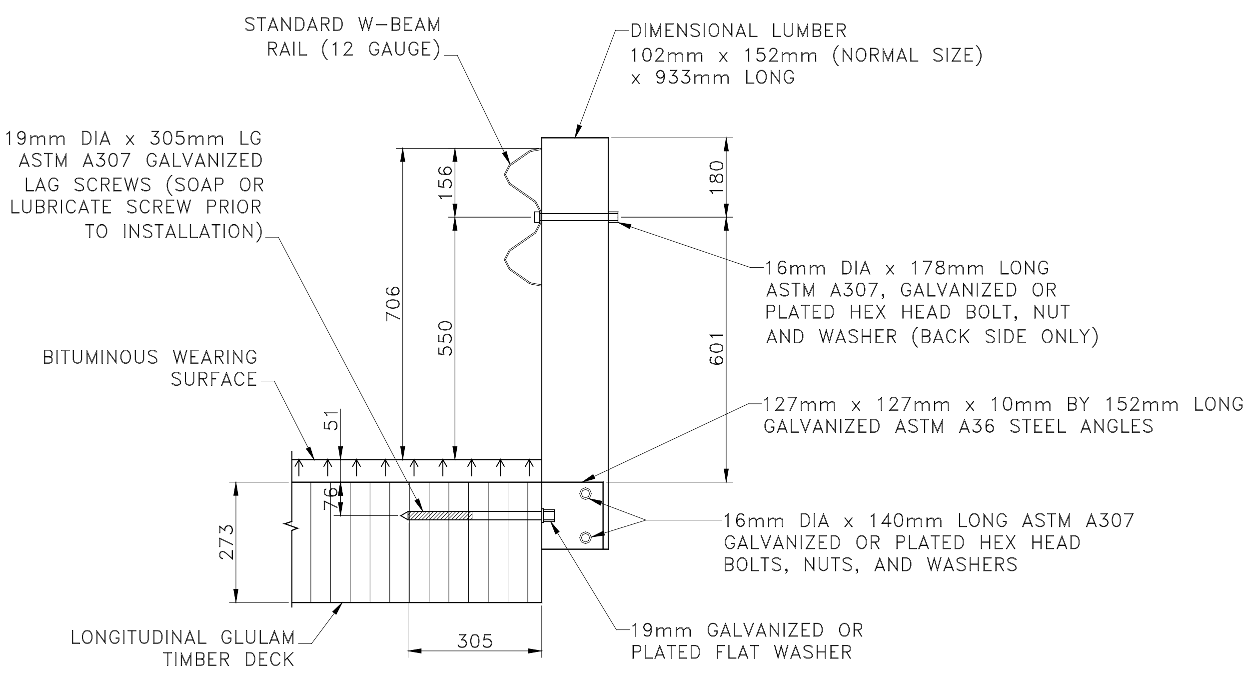

FIGURE 1: APPROVED TL-1 BARRIER

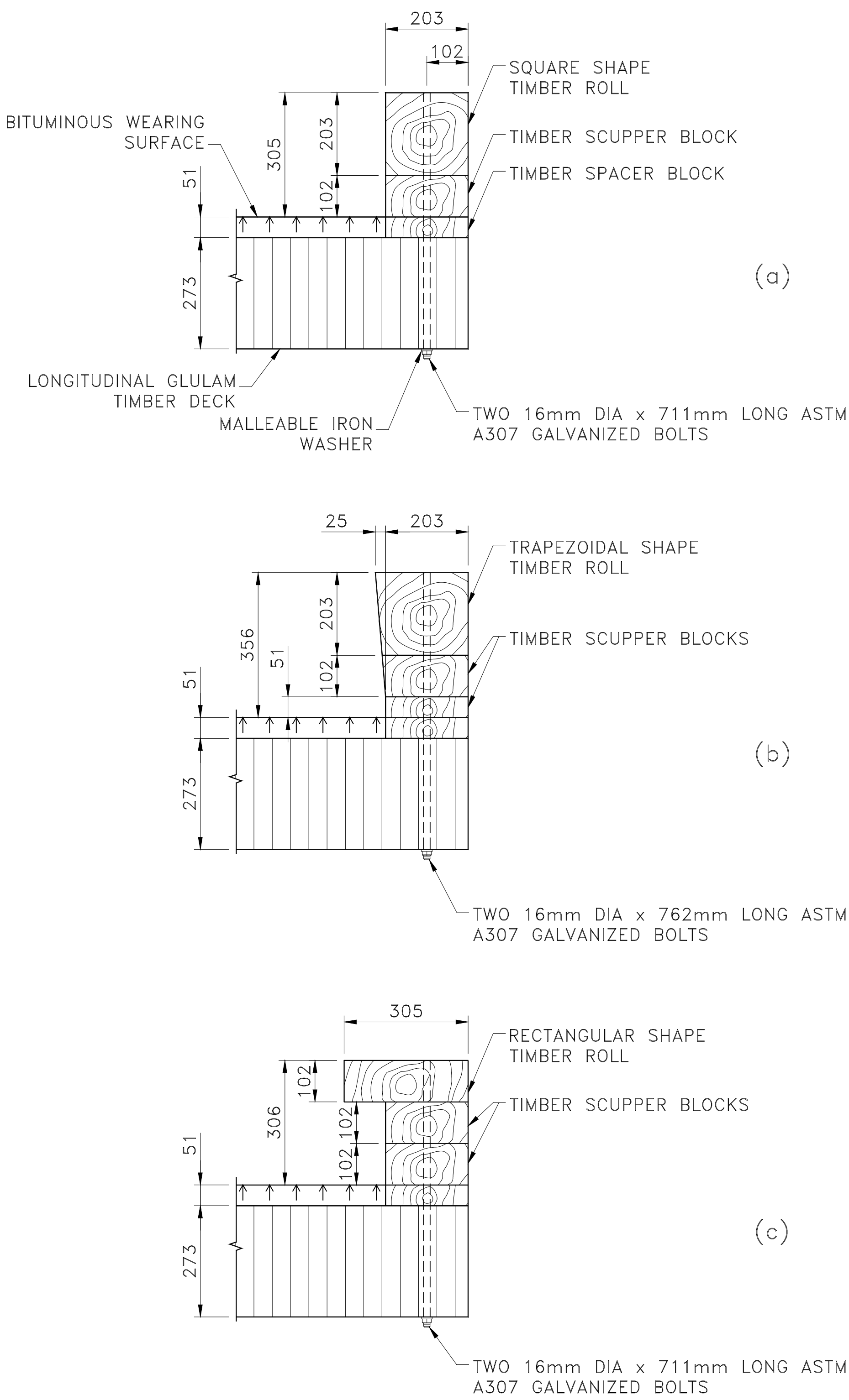

FIGURE 2: APPROVED TL-0 BARRIER SYSTEMS

REFERENCES

1. J. Greenstein, Issues Related to Administration of Low-Volume Roads in Developing Countries, Transportation Research Board 1426.
2. Geometric Design Standards for Ontario Highways.
3. TAC Geometric Design Guide for Canadian Roads.
4. E. Otte, V. Wyle, and A.J. Pienaar, Low-Level Stream Crossings in Developing Areas. Sixth International Conference on Low-Volume Roads.
5. MTO Drainage Management Manual.
6. H.V.S. Gangarao, M.J. Hegarty, Development of New Design and Construction Guidelines for Low-Volume Road Bridges, Transportation Research Record 1106.
7. Ontario Highway Bridge Design Code, 2nd Edition, 1983.
8. Ronald K. Faller, Barry T. Rosson, Dean L. Sicking, University of Nebraska-Lincoln, Michael A. Ritter, Forest Products Laboratory, USDA Forest Service, Steve Bunnell, USDA Forest Service, Washington, D.C., Design and Evaluation of Two Bridge Railings for Low-Volume Roads, Sixth International Conference on Low-Volume Roads.
9. Canadian Highway Bridge Design Code, (CHBDC). “CANA-S6-14”
10. Canadian Standards Association, Engineering Design in Wood, CSA Standard CSA-086-14.
11. Alberta Transportation and Infrastructure, Design Bulletin #1, Navigable Waters Protection Act Approvals for Bridge Projects, May 14, 2004.
12. Ontario Ministry of Transportation (MTO), Highway Drainage Design Standards, January, 2008.

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STRUCTURAL MANUAL

DIVISION 2 – PROCEDURES

September, 2016

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1 INTRODUCTION

1.1.1 GENERAL

The procedures in this division are to be followed where practical, when preparing structural contract documents for the Ministry. The preparation of contract documents and quantities, and the referencing of Ontario Provincial Standard Specifications (OPSS) are not covered in this manual. Technical revisions and additions to the Procedures Division are indicated by the date shown in the left portion of the header title block.

When additions or revisions are necessary, they will be made available through Publications Ontario or the MTO Research Library online website, as detailed in section 1.1.5.

1.1.2 DEFINITIONS

For the purpose of this manual the following definitions apply:

Average Annual Daily Traffic (AADT): means the total yearly traffic volume on a given road, in all lanes and both directions, divided by the number of days in the year.

Engineer: means a member or licensee of the Professional Engineers Ontario, who carries out the design or checking of a rehabilitation, design or evaluation of a bridge or structure.

Ministry: means Ministry of Transportation, Ontario.

MTO: means Ministry of Transportation, Ontario.

1.1.3 STANDARD DRAWINGS FORMAT

The following two formats are used for Structural Standard (SS) drawings:

a. Standard drawings for attachment on or insertion into contract drawings in the manner specified in 2.5.9.

b. Standard drawings for use as contract drawings.

New standard drawings being issued in category (a) are generally in 216 x 279 mm format. For the purpose of this Introduction, standards in this category are referred to as "small size" standards.

Standard drawings in category (b) are issued in the structural contract drawing format. They contain two title blocks that must be completed by the user. For the purpose of this Introduction, standards in this category are referred to as "full size" standards.

In this manual, reduced scale copies of the full size standard drawings have been assembled in a separate category following the small size standards.

1.1.4 NUMBERING SYSTEM

Design aids bear the prefix DA and standard drawings bear the prefix SS. Procedures have no prefix. Except for full-size standard drawings (see later), the one or two digit number after the prefix, if there is a prefix, is the section number. All divisions use the same subject-oriented section numbering system. e.g., SS 13-3 would represent the section 13 of the procedures division, `Bearing Assemblies and Expansion Joints' - Sheet 3. The same principle applies to design aids.

The Standard drawing sheet numbers in the system are not completely sequential. This is to permit the addition of future sheets in the appropriate place without disrupting the numbering system.

In order to distinguish between the full size standard drawings and the small size drawings, the full size standard section numbers have been increased by 100.

E.g., SS 116-10

The first digit (1) of the first number group indicates that it is a full size drawing. The next two digits (16) show that the drawing belongs to section 16 (Miscellaneous).

1.1.5 DISTRIBUTION

Copies of the Manual and revisions may be obtained from:

Publications Ontario
800 Bay Street
Toronto, Ontario
Canada, M7A 1N8

Tel.:	416-326-5300
	800-668-9938
TTY:	800-268-7095
Fax:	613-566-2234
Website:	www.publications.gov.on.ca
Online:	www.mto.gov.on.ca/english/transrd/

1.1.6 AVAILABILITY OF STANDARD DRAWINGS

Electronic CAD files containing standard drawings in AutoCAD may be obtained from the CPS.

1.1.7 USE OF STANDARD DRAWINGS

Most standard drawings bearing an "SS" prefix require job-specific information to be added by the user. The job-specific information should be added at the time the standards are included in or attached to the drawings.

If details and notes as shown on SS standards are not applicable, they must be deleted, crossed through, or labelled "Not Applicable".

AutoCAD file names are established by removing one "S" from the standard drawing name prefix, and adding the extension "DWG".

The AutoCAD layer named "UPDATE" in the digital file, contains a revision information sheet for the current revision of the drawing.

AutoCAD files of structural standard drawings shall have the drawing and drawing check initial blocks filled in.

1.1.8 MODIFICATIONS TO STRUCTURAL STANDARD DRAWINGS

Standard drawings shall be reviewed to determine what information, if any, needs to be added to them.

Where information in tables and dimensions are added to a standard drawing for its completion, the drawing shall bear the seal, date and signature of an Engineer. This Engineer accepts full responsibility for the accuracy of the added information only.

Where details and notes shown on a standard drawing are not applicable and are deleted, crossed through, or labelled “Not Applicable”, the drawing shall be identified as “Modified” and bear the seal, date and signature of an Engineer. This Engineer accepts full responsibility for the modifications to the drawing only.

Where changes are made on a standard drawing that affect the original structural design, the drawing shall be identified as "Modified" and bear the seals, dates and signatures of two Engineers. These Engineers accept full responsibility for the design that results from the changes.

1.1.9 DD STANDARDS

In the past, a number of small size structural standards (SS) drawings which did not require the addition of job specific data, were converted into DD standards by the Highway Design Office. These were contained in Book 3 - Structural, of the Highway Engineering Standard Drawings Series and had numbers from DD 3000. Support for this manual has been discontinued by the Highway Design and Bridge Offices as all standard drawings in this manual have been replaced by either structural standard drawings (SS), Ontario provincial standard drawings (OPSD) or deleted.

1.1.10 ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD'S)

OPSD's are standards for provincial roads and municipal services which have been developed in consultation with provincial and municipal owners, designers and contractors. They are suitable for use by all owners and reflect a consensus of opinion about acceptable practices to ensure the owner's requirements for quality and the contractor's need for efficiency are satisfied.

OPSD's are provincial publications and are not automatically used by the Ministry. Those that the Ministry has implemented may be found in chapter H of the Ministry's Contract Design, Estimating and Documentation (CDED) Manual, and the CPS. Sometimes it happens that the Ministry implements or deletes standards prior to publishing in the CDED Manual. In this case, confirmation of implementation dates prior to CDED manual revisions will be shown on the CPS News File of the CPS Main Menu.

OPSD’s standards are to be referenced by number in the contract documents and are not to be included with the contract drawings.

Modifications to OPSD's shall follow the policy and procedures of the Ontario Provincial Standards Administration.

1.1.11 BRIDGE OFFICE POLICY MEMOS

Whenever an immediate change to manuals, codes, procedures, policies, or an innovation is required, the Bridge Office (formerly Structural Office) periodically issues 'policy' memos. These memos enable their content to be implemented on date of issue, thereby avoiding delay due to waiting for revision of the corresponding publication. Where conflict occurs with the content, the publication/memo with the latest date takes precedence.

Current policy memos may be obtained from the Manager, Bridge Office or the following web site.

http://www.mto.gov.on.ca/phmpmbp/Reference%20Materials.shtml#_Structural

2 GENERAL DESIGN AND DRAFTING

2.1.1 DESIGN SPECIFICATIONS

All structures with spans greater than 3 m shall be designed in accordance with the CHBDC. CHBDC clauses identified in this revision refer to the edition of the CHBDC published in December 2014. Structures supporting railway loading shall be designed to criteria provided by the railway authority.

2.1.2 DESIGN AND CHECK CALCULATIONS

For all Ministry bridges designed in-house, the design and check calculations, shall be filed with the Bridge Design Section, Bridge Office or Regional Structural Section as applicable. This shall be done by the design Engineer immediately after the checker's P.Eng. stamp has been placed on the drawings.

For consultant designs, a copy of calculations of the final new and rehabilitation bridge designs including any changes as a result of design checking shall be submitted to the Ministry project manager, within six (6) weeks of the executive review. The design calculations shall be submitted on letter or legal size paper. The use of any commercial computer software, its name and version shall be clearly identified and a hard copy of the input data and a sketch of computer model shall also be included with the design notes. If an in-house spread sheet type program is used then the hard copies of both the input and output files shall be submitted. The submission shall clearly identify the designer and checker and shall be dated. The project manager shall be responsible for adding the submission to the structure file copy for any future rehabilitation needs.

2.1.3 DESIGN FOR EARTHQUAKE EFFECTS

The Importance Factor shall be indicated in the structural planning report.

2.1.4 CRITICAL DESIGN DETAILS

During the design process for new and rehabilitated structures, the designer shall identify all critical details and ensure that they can be easily inspected after construction.

2.1.5 STEEL TRUSS AND ARCH DESIGN

Normally in the design and evaluation of steel trusses and arch structures connections are assumed to be pinned. However the effects of connection rigidity or seized pins shall also be considered during analysis to determine whether resulting bending stresses are acceptable and fatigue will not be an issue.

2.1.6 SHORED CONSTRUCTION FOR BRIDGES

For all girder bridges, the girders shall be designed for un-shored construction. If the need arises to design a concrete deck on girder structure for shored construction, approval for the method of construction as well as the method of design shall be obtained from the Bridge Office.

2.2.1 PROTECTION SYSTEMS

Excavations required for construction of foundations, culverts, and other below-grade components or structures are generally made with sloping sides or with vertical or near vertical sides. These conditions depend on a variety of factors such as available space, type of soil, water table, depth of cut, duration of work etc. In all cases, the conditions shall provide for the stability and protection of the new construction, adjacent existing structures, and the safety of the public and construction workers. Where the actual site, soil and neighbouring conditions will not permit construction with allowable slopes then supplementary measures shall be provided such as a "Protection system."

Protection systems are structures designed to protect and preserve existing structures, materials, utilities or other works while facilitating the safe construction of new work. Roadways, adjacent buildings, property, railways, existing bridge work (new and old), gas and water mains, are examples of items that may require protection. They are, in general, temporary structures required, essentially, to keep the earth and water out of excavations.

The type of retaining structure or protection system is selected by the contractor except as modified below. Contractors may design their schemes according to their proposed staging, available materials, expertise, and enterprise. The result shall be a scheme that is structurally adequate and economic to both the owner and contractor. The design shall not compromise the safety of the public, construction workers and the protection requirements.

The following policy applies to Ministry projects:

1. The complete design of protection systems shall not be detailed on the contract drawings, except as follows:

    a) Where the protection system will be incorporated into the final design of the structure.

    b) If the owner whose property is being protected, such as a railway company, requests a detailed design to be part of the contract documents.

    c) Special cases where the Ministry perceives that for significant safety concerns control of the design should remain with the Ministry. For these situations the structural design report shall justify the need for the detailed design.

    In order for the Ministry to still benefit from a contractor's design, construction ingenuity, experience, and ability to work through or around restrictions, the contractor may still submit alternate schemes. These, however, will only be allowed under certain conditions. Some important elements that should form part of these conditions are:

- There should be a cost saving which is shared with the contractor.
- The change proposal shall not compromise any essential design criteria, safety or preliminary engineering commitments.
- The change proposal cannot be the basis for a contract claim.

Where applicable, the above criteria shall be included in the contract documents.

2. When an anticipated protection system is not detailed, adequate information shall be given on the contract drawings to enable the contractor to design and construct a safe and economic protection system. Such information shall include all or some of the following:

   a) Approximate location

   b) Allowable slope geometry

   c) Earth pressure parameters

   d) Design bond stress for anchors where applicable

   e) Performance level

   f) Operational constraints

   g) Known utilities

   h) Live load surcharge

3. For all protection systems the design and construction shall meet the requirements of the Ontario Provincial Standard Specification OPSS 539 "Construction specification for temporary protection systems".

4. It is possible that a protection system may not be anticipated but required because of the contractor's method of operation. In this situation, drawings of the contractor’s proposal shall be submitted to the contract administrator as required by OPSS 539. Review of these cases will be at the discretion of the regional office.

5. The Ministry is responsible for the safety of the travelling public. All protection systems proposed by the contractor shall be reviewed where the safety of the public is involved.

6. The review of protection systems shall be the responsibility of the regional office. Where complexity or work load prevent a review within the four-week period before construction, the Bridge Office may be consulted at the discretion of the regional office.

For assistance in the design or review of protection systems the designer may consult the "Guide Design Specifications for Bridge Temporary Works" and the "Construction Handbook for Bridge Temporary Works," both published by AASHTO in 1995 with interim revisions published in 2008. Where conflict occurs in these publications with OPSS 539 or the recommendations of the Pavement and Foundation Section, the requirements of the latter shall take precedence.

2.2.2 SHEET PILING AROUND FOOTINGS

When sheet piling is to be left permanently in place around a footing, typically as scour or tremie concrete protection, it shall be shown on the contract drawings. The cut-off and tip elevations shall be shown, together with the minimum thickness and minimum section modulus per unit width. In this case, payment for such work shall be included in the tender item for concrete in footings.

Shoring and bracing required to do the work are usually not shown on the contract drawings, but shall remain the responsibility of the contractor.

2.2.3 FILL STAGES AT STRUCTURES

Where fill is to be brought up to footing level, piles (if any) driven, footings cast, and fill completed, the first fill stage or interim grade line shall be shown to the bottom of footing elevation on the general arrangement drawing.

When piles are to be driven through the fill, a note is required limiting the maximum particle size in the fill to 75 mm when steel H-piles are specified, and 50 mm when tube piles are specified. If either type of pile may be used, the maximum particle size for tube piles shall be specified.

2.2.4 SUB-EXCAVATION AND FILL AT STRUCTURES

When the foundation investigation report recommends sub-excavation of unacceptable material in the vicinity of structures and replacement with granular material, the type of granular material shall be established in consultation with the Foundation Design Section and the Regional Structural Section and shall be specified on the general arrangement drawing. The extent of sub-excavation is not shown on structural drawings. A note saying "FOR LIMITS OF SUB-EXCAVATION SEE GRADING DRAWINGS" is required, close to where the sub-excavation is indicated.

2.3.1 CONCRETE STRENGTHS

Concrete shall be specified by metric class. Classes listed below are for <u>normal</u> concrete, and not HPC. For HPC class requirements see the corrosion protection guidelines for concrete bridge components in section 2.8.2. Accepted minimum <u>normal</u> concrete classes with their normal applications are as follows:

CLASS	APPLICATIONS
15 MPa	Not used for structural purposes
20 MPa	Not used for structural purposes

25 MPa	Not used for structural purposes
30 MPa	Used in decks, curbs, sidewalks, approach slabs, barrier walls, cast-in-place concrete culverts and for sub-structures.
35 MPa	For prestressed post-tensioned concrete, columns where strength requirements dictate, and cast in place segmental structures.
40 MPa	Precast prestressed beams and precast segmental units. (see also section 7.2.1)

For special applications, where size or weight must be minimised, higher strengths may be authorised.

Concrete strengths required at transfer of prestress are not classes. They may be specified between 20 MPa and the class strength for post-tensioned concrete, and between 25 MPa and the class strength for pre-tensioned concrete. It is very important for the production of precast and prestressed components that the designer specifies the minimum value, rounded down to the nearest MPa, which the Code SLS requirements at transfer will permit.

2.3.2 AVAILABILITY OF CONCRETE WITH STRENGTH IN EXCESS OF 30 MPA

There are areas in the province where, for cast-in-place concrete, strengths in excess of 30 MPa are difficult to obtain.

When high strength cast-in-place concrete is proposed for a structure and information as to its availability is not given in the structural planning report or in related correspondence, the Head, Regional Structural Section, shall be asked to confirm, in writing, the availability of concrete meeting the proposed requirements before the final design is begun. The required concrete strength shall be shown on the preliminary version of the general arrangement drawing.

2.4.1 COVER TO REINFORCING STEEL, P.S. STRANDS, AND P.S. TENDON DUCTS

The nominal cover and tolerance specified on drawings shall be as per Table 2.4.1. The information in this table is derived from CHBDC Table 8.5, but is not complete in that only the most common member types and exposure conditions are listed. For member types, surfaces and exposure conditions not listed in Table 2.4.1, the designer shall refer to chapter 8 of the CHBDC.

In detailing and scheduling reinforcing steel it is important to ensure that nothing will prevent obtaining the specified cover. Particular attention is drawn to the following:

1. Stirrups which extend from the bottom to the top of the deck shall be sized to fit without causing an encroachment on the cover in any location. Generally this results in the stirrups being 120 mm min. less than the deck depth at the shallowest location where the stirrups are to be placed.

2. Stirrups shall not be hooked over the top-most reinforcing bars. They shall be hooked over bars in the lower layer of the top mat.

3. The appropriate standard drawing showing the method of supporting the reinforcing steel shall be referenced as follows:

   OPSD 3329.101 for thick slabs, OPSD 3329.100 for thin slabs (i.e., less than 300 mm thick).

4. If fanned bars are used, a location shall be found for them such that there is no encroachment on cover and that location shall be clearly shown in plan and section.

TABLE 2.4.1 – Concrete cover requirements

Type of Member or Exposure Condition	Reinforcing Bars (principal, ties, stirrups)	Pre-Tensioning Strands	Post-Tensioning Ducts
(A) Concrete <u>not</u> submerged or exposed to earth or de-icing chemicals			
a) Slabs(2)			
(i) Cast-in-place, Top	60 ± 20	---	80(1) ± 15
(ii) Top of bott. slab for rectangular voided deck	40 ± 10	---	60(1) ± 10
(iii) Cast-in-place, Soffit			
- slab < 300 mm thick	40 ± 10	---	60(1) ± 10
- slab ≥ 300 mm thick	50 ± 10	---	70(1) ± 10
(iv) Precast, Top	50 ± 10	70 ± 5	70 ± 10
(v) Top of bott. slab for rectangular voided deck	40 ± 10	55 ± 5	60(1) ± 10
(vi) Precast, Soffit, all slab thicknesses	40 ± 10	55 ± 5	60(1) ± 10
b) Buried Structures			
(i) Cast-in-place concrete	60 ± 20	---	80(1) ± 15
(ii) Precast concrete	40 ± 10	55 ± 5	60(1) ± 10
c) Precast Girders	30 + 10 or - 5	45 ± 5	50(1) ± 10
(B) Concrete cast-in-place against and permanently exposed to earth			
(i) Footings	100 ± 25	---	---
(ii) Caissons	100 ± 25	---	120 ± 15
(C) Concrete submerged or exposed to earth			
a) Footings, Piers, Abutments, Retaining Walls			
(i) Cast-in-place concrete	70 ± 20	---	90(1) ± 15
(ii) Precast concrete	55 ± 10	75 ± 5	80(1) ± 10
b) Buried Structures with greater than 600 mm of fill*			
(i) Cast-in-place concrete	60 ± 20	---	80(1) ± 15
(ii) Precast concrete	40 ± 10	55 ± 5	60(1) ± 10

Type of Member or Exposure Condition	**Reinforcing Bars** (principal, ties, stirrups)	**Pre-Tensioning Strands**	**Post-Tensioning Ducts**
(D) Concrete exposed to de-icing chemicals due to spray or run-off			
a) Slabs[2], Medians, Curbs and Sidewalks	70 ± 20	---	---
(i) Cast-in-place, Top	---	---	130[1] ± 15
- longitudinal ducts	---	---	90[1] ± 15
- transverse ducts (d_d ≤ 60 mm)	---	---	130[1] ± 15
- transverse ducts (d_d > 60 mm)	40 ± 10	---	60[1] ± 10
- top of bott. slab for rect. voided deck			
(ii) Cast-in-place, Soffit	40[3] ± 10	---	70[1] ± 10
- slab < 300 mm thick	60 ± 10	---	80[1] ± 10
- slab ≥ 300 mm thick	55 ± 10	70 ± 5	---
(iii) Precast, Top	---	---	120[1] ± 10
- longitudinal ducts	---	---	80[1] ± 10
- transverse ducts (d_d ≤ 60 mm)	---	---	120[1] ± 10
- transverse ducts (d_d > 60 mm)	40 ± 10	55 ± 5	60[1] ± 10
- top of bott. slab for rect. voided deck			
(iv) Precast, Soffit	40[3] ± 10	60 ± 5	65[1] ± 10
- slab < 300 mm thick	50 ± 10	65 ± 5	70[1] ± 10
- slab ≥ 300 mm thick			
b) Buried Structures	70 ± 20	---	90[1] ± 15
(i) Cast-in-place concrete	50 ± 10	65 ± 5	70[1] ± 10
(ii) Precast concrete			
	35 + 10 or - 5	50 ± 5	55[1] ± 10
c) Precast Girders			
(E) Components, surfaces and environmental exposure other than those specifically mentioned in (A) to (D)	See CHBDC Table 8.5		

<u>Notes:</u> dimensions are in mm
d_d = outside diameter of ducts
* Buried structures with < 600 mm of fill shall have a distribution slab
(1) Greater of 0.5 d_d or indicated cover.
(2) For concrete decks without waterproofing and paving, increase the concrete covers by 10mm to allow for wear of the surface concrete.
(3) MTO policy

2.5.1 SITE AND DRAWING NUMBERS

<u>SITE NUMBERS</u>

Every structure designed for the Ministry and within Ministry right-of-way in Ontario is identified by an alphanumeric designation. This identifier, also called a “site number”, indicates the structures location and type. To obtain a structure identifier or “site number”, the Bridge Office shall be contacted to obtain a “Site ID Request Form”. This form, which requires location information including a key map in congested areas, must be submitted to the Bridge Office in order to be issued with a “site number”. The site number is determined by incrementing the last site number issued in the particular county or municipal district where the structure is located. Where several new site numbers are required along a particular route, the request for “site number” should be made in a group to obtain a block of consecutive numbers.

This identifier comprises three elements XX(L), XXXX and (/MX) which together are used in the following format:

XX(L)-XXXX(/MX)

where "X" represents a number, "L" or "M" a letter and () is optional depending on conditions as detailed below.

XX(L) is the county number except in some northern areas of the province where municipal district numbers are used. In the latter case municipal districts 38, 39, 41, and 48 have alphabetic characters (L), N (North), S (South), E (East), W (West), and C (Central) added after their number because of the large area they cover.

Examples:	48C	Thunder Bay	37	York
	39E	Cochrane	3	Carleton

XXXX is the actual site number used to identify the location of a structure within a given county or municipal district. It is unique within these boundaries. Where two or more structures occur parallel to each other, they may have the same site number but distinguished as shown below. For structures in series, i.e. along the highway they should be given separate numbers. Leading zeroes are not required in the site number.

Examples: 48C-87
3-220
37-1175

(/MX) where (M) represents the type of structure, and (X) whether there is more than one structure having the same site number. This is illustrated below for various structure types.

BRIDGES

M is left blank for all bridges.

The single digit number "X" after the type of structure is used when there is more than one structure having the same site number. This shall be used to identify twin structures or bridges at the same location such as a core/collector system. Ramps should be assigned unique site numbers. For this situation the following values for "X" shall apply:

X = 1
(a) Structures carrying northbound, or the eastbound lanes on twin structures.
(b) Structures carrying northbound or eastbound collector lanes of a core/collector system.

X = 2
(a) Structures carrying southbound, or the westbound lanes on twin structures.
(b) Structures carrying southbound or westbound collector lanes of a core/collector system.

X = 3
Structures carrying northbound or eastbound core lanes of a core/collector system

X = 4 Structures carrying southbound or westbound core lanes of a core/collector system

Example: 37-1234/2 Twin bridge carrying southbound lanes

CULVERTS

Site numbers are only assigned to culverts with spans greater than 3 m. For these cases M=C. Where there is more than one culvert at a site they shall be assigned unique site numbers.

Example 48C-1234/C

TEMPORARY MODULAR BRIDGES

For this case M=B. Previously Temporary Modular Bridges (TMB) were assigned the letter "B" as the M designation. Although B represented Bailey structures, it shall represent all TMB's, even permanent ones.

Example 34-222/B

OVERHEAD SIGN SUPPORTS

These are not assigned site numbers. They may be identified by a number allocated by the district bridge & sign installation crew.

RETAINING WALLS

For this case M=W. Where there is more than one retaining wall at a site they shall be assigned unique site numbers.

Example 39N-1234/W

REHABILITATIONS

See "Drawing Numbers" below.

Once a number is assigned to a structure, it shall not be changed even after the structure has been modified, replaced by another or when the direction of travel has changed.

DRAWING NUMBERS

Final drawings for all new structures are numbered consecutively with numbers only.

Preliminary drawings are numbered with the letter P1 for the first scheme. If preliminary drawings are revised and re-issued, the number is incremented, e.g. from P1 to P2. If more than one preliminary scheme is prepared, the drawings are numbered PA1, PB1 etc. For cases where there is more than one drawing per scheme then it shall be numbered PA1, PA2, etc.

Rehabilitations or modifications shall be numbered with the prefix RX-1, 2, etc., where X represents the number of times it has been rehabilitated.

In the following examples, the simplest and the most complex results are shown, however improbable the latter.

Examples:	50	A bridge final, fiftieth drawing
	P1	Bridge preliminary, one scheme, one drawing
	PA2	Bridge preliminary, first scheme, second sheet
	R4-P1	Bridge rehabilitation preliminary, fourth rehab, one proposal
	R4-12	The above rehabilitation, final drawing, twelfth sheet

2.5.2 SEQUENCE AND TITLES OF STRUCTURE DRAWINGS

For all types of bridges:

General Arrangement
Borehole Locations and Soil Strata
Roadway (Track) Protection
Foundation Layout
Footing Reinforcement
Foundation Layout and Footing Reinforcement
North (West) Abutment
North (West) Wingwall
South (East) Abutment
South (East) Wingwall
Abutments
Wingwalls (and Retaining Walls)
Retained Soil System
Piers
Bearings
Piers and Bearings

For bridges with post-tensioned decks:

Deck Details
Longitudinal Tendons I, II, etc.
Transverse Tendons I, II, etc.

For bridges with precast, prestressed concrete girders:

Prestressed Girders
Prestressed Girders and Bearings
Deck Details

For bridges with steel girders:

Structural Steel I, II, etc.
Deck Details

For all types of bridges:

Deck Reinforcement
Joint Anchorage and Armouring
Barrier Wall with Railing
Barrier Wall w/o Railing
Railing for Barrier Wall
6000mm Approach Slab
Details of Concrete Slope Paving
As Constructed Elevations and Dimensions.
Pile Driving Control
Standard Details I, II, etc.
Electrical Embedded Work
Quantities - Structures I, II, etc.

2.5.3 EXISTING BRIDGES - ACCESS TO CONTRACT DRAWINGS

Requests for electronic files or prints (not originals) of the contract drawings and shop drawings of existing bridge structures shall be submitted to the Regional Structural Section. The Regions Structural Section can contact the Bridge Office if the drawings are not available within the region.

2.5.4 WATER LEVEL DESIGNATIONS

The following procedure shall apply to the designation of water levels on drawings:

a. A water level shall be shown.

b. The water level shown shall be a factual one, i.e. - an elevation taken at some specific time, such as when the profile was run and E plan contours obtained. This elevation shall be shown on the drawings with the date, e.g. "429.00 (day/month/year)."

c. If more than one elevation is known, the Regional Structural Section Head shall be consulted.

d. In addition to the above, an estimated High Water Level (HWL), required for the assessment of waterway opening, shall be shown on the preliminary version of the general arrangement drawing only. This water level shall be removed for the final version.

e. The Regional Structural Section shall be responsible for supplying all pertinent water levels in the structural planning report.

f. When the Regional Structural Section deems it prudent, an additional water level, to be used for the design of protection schemes, shall be included on the general arrangement drawing with the note:

PROTECTION SCHEME DESIGN WATER LEVEL ________

2.5.5 USE OF WORD "MINIMUM" ON DRAWINGS

There is a possibility of a contractor taking advantage when the word "minimum" is used to specify the depth of footing or the depth to which a footing is to be recessed into rock. When the word "minimum" is used in such a manner, the Ministry may be obliged to pay for unnecessary over-excavation and additional concrete.

The word "minimum" shall not be used in such cases. The required depth of footing and the required recess into rock should be shown (see 4.3.1). The word "minimum" shall not be used to specify the strength of concrete, as it results in a conflict with the strength requirements in OPSS 1350. Concrete shall be specified by metric class (see 2.3.1).

2.5.6 NOTES AND LABELS FORMING PART OF VIEWS & DETAILS

Notes placed on views or details, describing components or requirements shall be precise, unambiguous, contain no unnecessary words, and be used only when necessary.

A few which may give trouble are as follows:

a. "Barrier wall and rail". There is no need for the word "Standard". The note shall state whether or not there is a rail. This note is required on the preliminary and final versions of the general arrangement drawing, on the elevation. It shall not be repeated on the cross section.

b. "Slope paving (typ.)". There is no need for other description and the note shall appear only once on the elevation.

c. "Top of concrete end dams to suit pavement profile". This note shall always appear on the abutment drawing.

d. "Top of cleat to be cast 35 mm below approach slab ledge". Reference to the styrofoam or neoprene is unnecessary since this is on the approach slab drawing. Reference to the approach slab is undesirable, since even if a slab is detailed, it may be subsequently deleted.

e. Notes calling for the removal of formwork or expanded polystyrene shall never be used. The specifications require all formwork be removed and if expanded polystyrene is not to be left in place, it shall not be shown at all.

f. Notes concerning construction joint grooves and sealing shall not duplicate or conflict with OPSD-3950.100 if this standard is included in the drawings.

2.5.7 GENERAL NOTES

The following are standard notes of the type shown below the title block on the general arrangement drawing. The notes shall be worded to cover the requirements specific to the particular project and should only be used if applicable. Other notes may be required in special circumstances.

In specifying the classes of concrete, different components may be itemised together if the classes are the same.

For clarity the wording of the notes is shown in upper case (capital) lettering. Explanations shown in brackets in lower case lettering are not part of the notes.

(a) GENERAL ARRANGEMENT DRAWINGS - SLAB -ON-GIRDER BRIDGES

1. CLASS OF CONCRETE

(Example, see 2.3.1)

30 MPa

CLASS OF CONCRETE FOR PRECAST GIRDERS ARE GIVEN ON PRESTRESSED GIRDER DRAWINGS

2. CLEAR COVER TO REINFORCING STEEL

FOOTINGS		100 $\pm$ 25	
DECK	TOP	70 $\pm$ 20	
	BOTTOM	40 $\pm$ 10	
PIER CAPS		70 $\pm$ 10	
REMAINDER		70 $\pm$ 20	UNLESS OTHERWISE NOTED

3. REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400W.

UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS B.

STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

BAR MARKS WITH PREFIX ‘S’ DENOTE STAINLESS STEEL BARS.

GLASS FIBRE REINFORCED POLYMER REINFORCING BARS SHALL BE GRADE I, GRADE II OR GRADE III AS SPECIFIED IN THE

CONTRACT DRAWINGS. THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.

BAR MARKS WITH THE PREFIX GI DENOTE GRADE I GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GII DENOTE GRADE II GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE. (The designer shall include SS12-1 on the contract drawings).

4. RETAINED SOIL SYSTEM (where applicable)

RETAINED SOIL SYSTEM WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:

APPLICATION: (To be completed according to MTO RSS guidelines)

PERFORMANCE: (To be completed according to MTO RSS guidelines)

APPEARANCE: (To be completed according to MTO RSS guidelines)

5. CONSTRUCTION NOTES

(Notes as applicable, see list under 2.5.7(d) below)

(b) GENERAL ARRANGEMENT DRAWINGS - CONCRETE RIGID FRAMES and INTEGRAL ABUTMENTS

1. CLASS OF CONCRETE

30 MPa

2. CLEAR COVER TO REINFORCING STEEL

FOOTINGS		100 ± 25	
DECK	TOP	70 ± 20	
	BOTTOM	50 ± 10	
REMAINDER		70 ± 20	UNLESS OTHERWISE NOTED

3. REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.

UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS B.

STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN or DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

BAR MARKS WITH PREFIX ‘S’ DENOTE STAINLESS STEEL BARS.

GLASS FIBRE REINFORCED POLYMER REINFORCING BARS SHALL BE GRADE I, GRADE II OR GRADE III AS SPECIFIED IN THE CONTRACT DRAWINGS. THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.

BAR MARKS WITH THE PREFIX GI DENOTE GRADE I GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GII DENOTE GRADE II GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE. (The designer shall include SS12-1 on the contract drawings).

4. RETAINED SOIL SYSTEM (where applicable)

RETAINED SOIL SYSTEM WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:

APPLICATION: (To be completed according to MTO RSS guidelines)

PERFORMANCE: (To be completed according to MTO RSS guidelines)

APPEARANCE: (To be completed according to MTO RSS guidelines)

5. CONSTRUCTION NOTES

BACKFILL SHALL NOT BE PLACED BEHIND THE ABUTMENTS UNTIL THE DECK SLAB IS IN PLACE AND HAS REACHED 70% OF ITS DESIGN STRENGTH.

(See 11.1.1 for Exception)

BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500 mm.

(See 11.1.1 for note to be used for special site access conditions)

CONSTRUCT ABUTMENTS AND WINGWALLS TO THE BEARING SEAT ELEVATIONS. THE CONTRACTOR SHALL SUPPLY TEMPORARY LATERAL BRACING FOR THE ABUTMENTS. FORMWORK AND LATERAL BRACING SHALL NOT BE REMOVED UNTIL CONCRETE HAS REACHED 70% OF ITS SPECIFIED 28-DAY STRENGTH.

(Other notes as applicable, see list under 2.5.7(d) below).

(c) GENERAL ARRANGEMENT DRAWINGS - CAST-IN-PLACE POST-TENSIONED CONCRETE BRIDGES

1. CLASS OF CONCRETE

DECK & SIDEWALKS	35 MPa
REMAINDER	30 MPa

2. CLEAR COVER TO REINFORCING STEEL

FOOTINGS		100 $\pm$ 25
<u>ROUND VOIDED DECKS</u>		
DECK	TOP	70 $\pm$ 20
	BOTTOM AND SIDES	50 $\pm$ 10
REMAINDER		70 $\pm$ 20 UNLESS OTHERWISE NOTED
<u>RECTANGULAR VOIDED DECKS</u>		
DECK	TOP SLAB, TOP	70 $\pm$ 20
	BOT	40 $\pm$ 10
	BOT SLAB, TOP	40 $\pm$ 10
	BOT	50 $\pm$ 10
	WEBS	60 $\pm$ 10
REMAINDER		70 $\pm$ 20 UNLESS OTHERWISE NOTED

3. REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.

UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS B.

STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX

2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

BAR MARKS WITH PREFIX ‘S’ DENOTE STAINLESS STEEL BARS.

GLASS FIBRE REINFORCED POLYMER REINFORCING BARS SHALL BE GRADE I, GRADE II OR GRADE III AS SPECIFIED IN THE CONTRACT DRAWINGS. THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.

BAR MARKS WITH THE PREFIX GI DENOTE GRADE I GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GII DENOTE GRADE II GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE. (The designer shall include SS12-1 on the contract drawings).

4. RETAINED SOIL SYSTEM (where applicable)

RETAINED SOIL SYSTEM WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:

APPLICATION: (To be completed according to MTO RSS guidelines)

PERFORMANCE: (To be completed according to MTO RSS guidelines)

APPEARANCE: (To be completed according to MTO RSS guidelines)

5. CONSTRUCTION NOTES

(Notes as applicable, see list under 2.5.7(d) below)

(d) CONSTRUCTION NOTES (to be used where applicable)

"THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT. (In addition to the preceding note, the following shall be shown on the drawing where top of bearing elevations are shown: Top of bearing elevations shall be denoted with an asterisk(*), and add note,) " * SEE CONSTRUCTION NOTES ON DRAWING 1 ".

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DETAILS AND ELEVATIONS OF THE EXISTING STRUCTURE THAT ARE RELEVANT TO THE WORK SHOWN ON THE DRAWINGS PRIOR TO COMMENCEMENT OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE CONTRACT ADMINISTRATOR AND THE PROPOSED ADJUSTMENT OF THE WORK REQUIRED TO MATCH THE EXISTING STRUCTURE SHALL BE SUBMITTED FOR APPROVAL. (Use for the rehabilitation of structures).

SIDES OF FOOTINGS TO BE CAST AGAINST UNDISTURBED SOIL.
(Use when factored horizontal forces exceed factored sliding resistance at the bottom of footing).

SHEET PILING INDICATED ON THE CONTRACT IS REQUIRED AS A PERMANENT PART OF THE STRUCTURE. IT IS NOT INTENDED TO REPRESENT A COMPLETE SHORING SCHEME. (Use when sheet piling is indicated on the contract.)

CONCRETE BARRIER WALLS ON RETAINING WALLS SHALL NOT BE CAST UNTIL THE RETAINING WALL BACKFILL HAS BEEN COMPLETED.

COMPACTED FILL, MAXIMUM GRAIN SIZE 50 mm SHALL BE PLACED UP TO THE BOTTOM OF FOOTING ELEVATION PRIOR TO DRIVING PILES (See 2.2.3, 50 mm is for tube piles).

EXISTING ROADBED IN AREAS THROUGH WHICH PILES MUST PENETRATE TO BE REMOVED BEFORE PLACING FILL.

NO CHAINS, HOOKS OR PEAVIES SHALL BE USED IN HANDLING TREATED WOOD. SURFACES EXPOSED BY FIELD CUTTING OR DRILLING SHALL BE TREATED BY SOAKING WITH AN APPROVED PRESERVATIVE EQUAL IN TOXICITY TO THE ORIGINAL PRESERVATIVE. THREE APPLICATIONS ARE REQUIRED, EACH TO AIR DRIED SURFACES. (Use only for treated wood).

IF THE DEPTH OF BLOCKOUT FOR THE SELECTED MODULAR JOINT IS DIFFERENT FROM THAT GIVEN ON THE MODULAR EXPANSION JOINT ASSEMBLY DRAWINGS, THE CONTRACTOR SHALL ADJUST THE DEPTH OF BLOCKOUT AND THE REINFORCING STEEL TO SUIT THE SELECTED MODULAR JOINT.

(e) (For structural plate corrugated steel structures only. Only standard metric material may be used).

STRUCTURAL PLATE CORRUGATED STEEL PIPE SHALL CONFORM TO CSA G401-, EXCEPT THAT THE ZINC COATING MASS (TOTAL ON BOTH SIDES) SHALL BE NOT LESS THAN 915 g/m^2 WHEN TESTED BY THE TRIPLE SPOT TEST (TST). NOMINAL BASE METAL THICKNESS (give) mm. LONGITUDINAL SEAM BOLT SPACING (give number) PER CORRUGATION.

PRIOR TO ALLOWING HEAVY CONSTRUCTION EQUIPMENT OVER THE STRUCTURE, THE DEPTH OF COMPACTED COVER MATERIAL SHALL BE NOT LESS THAN (give depth).

(f) STRUCTURAL STEEL NOTES

(See 8.8.2)

(g) PRE-TENSIONED GIRDER DRAWINGS

(See 7.2.7)

(h) POST-TENSIONED DECK NOTES

(See 7.3.12)

(i) PRESERVATIVE TREATED WOOD STRUCTURE DRAWINGS

(See 15.2.1)

(j) MISCELLANEOUS

1. No instruction or note on the drawings shall imply that there is more than one contractor. For example, reference must be to "THE CONTRACTOR" only and not to "THE STRUCTURAL STEEL CONTRACTOR".

2. For temperatures, only the Celsius scale shall be used. Temperatures shall be shown thus: 23^{o}C, 0^{o}C, - 10^{o}C, etc.

2.5.8 GENERAL ARRANGEMENT DRAWINGS - CONTENT AND FORMAT

The following instructions are not exhaustive and are intended only to provide guidance in the preparation and checking of general arrangement drawings. The general arrangement drawing shall appear within the master drawing border for which a reduced scale hardcopy is shown in Figure 2.5.8(a). Line thicknesses and text sizes given are specified to ensure legibility after drawing reduction. A "**thin**" line shall be as thin as can be depended upon to print clearly after 1/2 size reduction. This width is between 0.2 and 0.3 mm. A "**medium**" line width is between 0.35 and 0.5 mm and a "**thick**" line shall have a width between 0.6 and 0.7 mm. Text need be used in only three sizes: **large** 4 to 4.5 mm high, **medium** 3 to 3.5 mm, and **small** 2.5 mm. Vertical, uppercase, Roman Simplex text font is preferred. Large text within the title block shall be done, using 3.5 mm text height.

<u>**TITLE BLOCK**</u>

The name of the structure and the W.P. number shall be as given in the structural design report.

For clarification in the use of some terms, such as, underpass, overpass, subway and overhead, see Figure 2.5.8(b).

The Contract number and the sheet number shall be left blank since it will be completed by others at the time of tendering.

The district number shall be given above the contract number only on the general arrangement drawing. The standard north point shall be shown on the general arrangement drawing and on others, where required by the contents of the drawing.

The drawing title shall be as given in 2.5.2.

The highway number is not required in the title block but shall appear somewhere on the plan.

REVISION BLOCK

All revisions, after tender prints have been prepared, must be identified by a number placed in a hexagon. In the "Revision" column, the same symbol shall be used. The date, initials of the drafter making the changes and a short description of the nature of the revision shall be given also.

INITIAL BLOCK

All blocks shall be filled as indicated below and illustrated on Figure 2.5.8(a).

DESIGN	Initials of actual designer with responsibility for the design. For the general arrangement drawing the initials shall indicate general responsibility for the preliminary design, and not that complete design computations have been carried out.
CHK (DESIGN)	Initials of actual checker with responsibility for checking the design.
CODE	Name of design code used in design. For current MTO projects this is the Canadian Highway Bridge Design Code and shall be designated as CHBDC. For railway structures this may be American Railway Engineering & Maintenance of Way Association Manual for Railway Engineering (AREMA).
LOAD	Loading used in design specified in the above applicable code. For new MTO highway structures this will be CL-625-ONT. Railway loading may be according to AREMA and rehabilitations as per sections 14 and 15 of the Canadian Highway Bridge Design Code.
DATE	The month and year when final drawings were completed and submitted to the Regional Structural Sections, stockpiled, or sent to Planning and Design.
DRAWN	Initials of drafter or technician who produced the drawing.
CHK (DRAWN)	Initials of checker with responsibility for checking accuracy, dimensions, geometry, etc. of the drawing.

SITE	Add site number as per 2.5.1.
DWG	Add drawing number as per 2.5.1.

KEY PLAN

A key plan is not required on the general arrangement if it is to appear on the soils drawing or elsewhere on a drawing that will remain on the structural file and appear in the contract documents.

If a key plan is required, it shall normally be to a scale of 1:50 000, not smaller than 100 mm x 100 mm and not larger than 150 mm x 150 mm and appear just to the left of or below the title block (top right-hand corner). The structure site shall be clearly indicated, and the plan shall be oriented with north to the top and a north point shown. If a place shown on the Ontario road map does not occur within the key plan, notes shall be added indicating the direction and distance of two such places along routes appearing on the key plan. If this is not practicable, a smaller scale plan shall be considered.

The key plan shall show only major roads, railroads, rivers, lakes and towns. The roads shall be shown in **thick** single lines, railroads thus +++++++++++++, lakes and rivers in **thin** "shaky" lines. Double parallel lines shall be avoided unless, for example, a river is of great width. The title of "Key Plan" shall appear below the plan in **large** text with a scale in **small** text that is also given as a graduated line. A **medium** line border shall surround the plan itself with a **thick** line border around plan, title and scale.

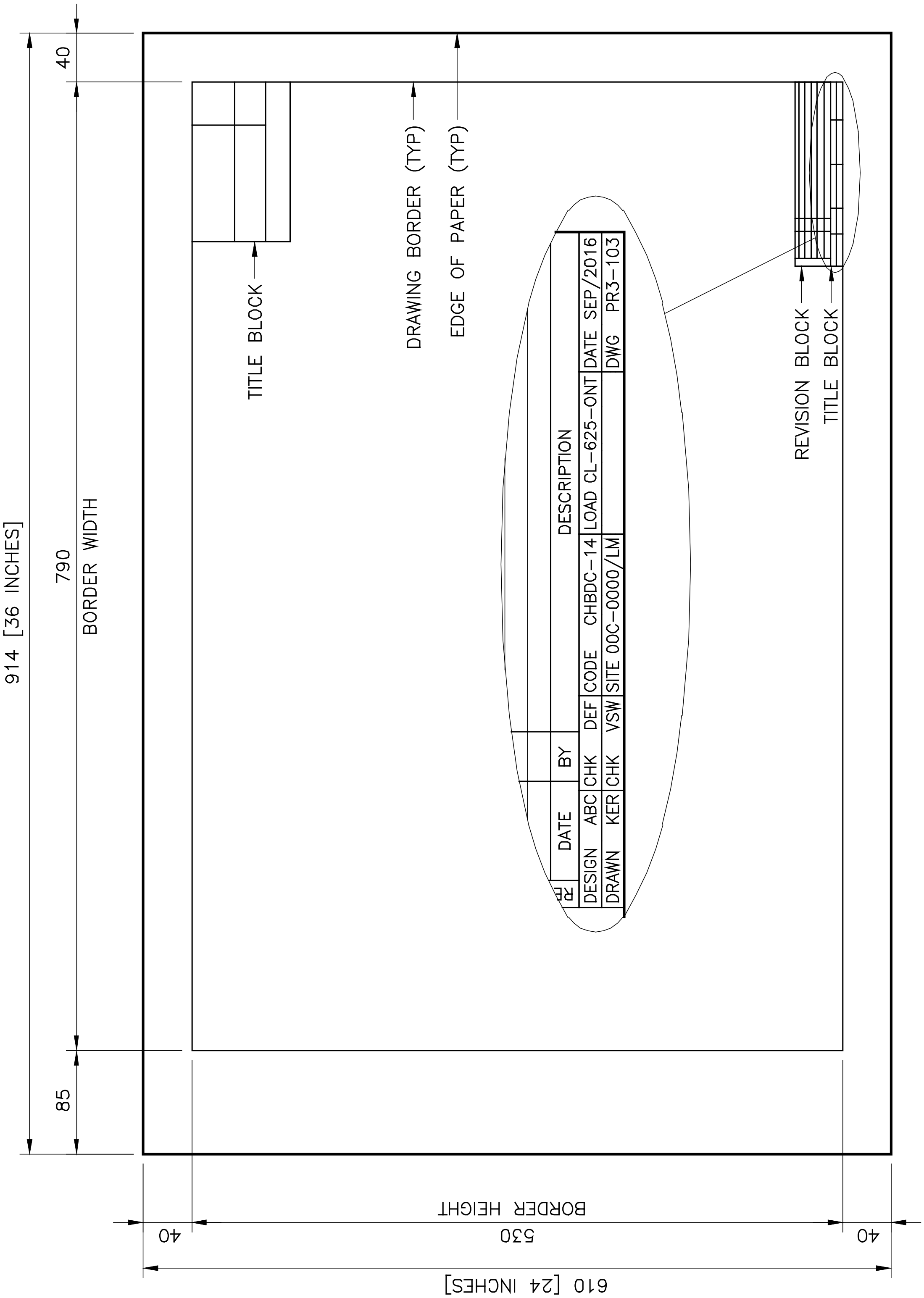


FIGURE 2.5.8(a) MASTER DRAWING BORDER

PLAN

The plan, located at the top and left portion of the drawing, shall be to a scale of 1:200 unless the size of the structure precludes this, in which case scales of 1:250, 1:500, 1:750, 1:1000, 1:1250 shall be considered to obtain the largest plan possible within the space limits of the master drawing border.

The plan shall be oriented with the upper roadway direction as nearly horizontal as possible and with the chainage increasing from left to right, if this can be arranged. A standard north arrow shall be shown in the space provided in the title block. A north arrow, rotated up to 45^{o} from true north may also be shown on the plan and marked "North for Construction", but this shall be done only if the various parts of the structure could not otherwise be unambiguously named.

North arrows that point downwards are very undesirable and shall not occur normally because chainages throughout the province are supposed to increase from west to east and from south to north. If it is found that the north point points downwards, the problem shall be discussed with Regional Planning and Design to find out if the chainage direction was correctly determined and to ensure consistency between the road and bridge drawings.

Existing contours shall always be shown, dashed (or dotted) if and where new work will change them and solid if not. If final contours are available or are specifically requested, these shall be shown, using short-dashed lines in this case for all existing contours. Contours normally are required at 1 m intervals but larger intervals may be used for steep surfaces. Lines used shall be **thin**, except that 5 m interval contours may be of **medium** thickness.

On the plan, the following are required:

Creek water edges in **thick** lines, consistent with the given water level and ground contours; direction of flow; name of creek in **large** text written along the creek and to be read from the right-hand side of the drawing.

All centre lines and control lines, pier centre lines and abutment bearing centre lines in **thin** centre lines.

Edges of pavement, except on a bridge deck where no physical demarcation other than painted lines will exist; curbs and copings; approach slabs; deck-ballast wall joints; top and bottom of slopes; shoulder edges, retaining wall, pier and wingwall stems, when not hidden, and drainage openings shall be shown in lines of **medium** thickness. Railings shall not be shown.

Hidden work such as pier or column shafts, abutment faces and grading details under the structure shall be shown in **thin** dashed lines. Footing outlines shall be shown to indicate proximity to pavements, tracks, creeks, etc., but shall not be shown for abutments that are remote from such features. Services likely to affect or be affected by construction shall be indicated with centre lines and a description that includes the words "existing" or "proposed".

Unless a careful study of the structure by the project Engineer has indicated that none is required, the position and length of roadway or track protection shall be shown in **medium** double lines with the words "Track Protection" or "Roadway Protection" in **small** text. If it is necessary to show Traffic Protection, centre lines of **medium** thickness shall be used.

Dimensions for such as roadway widths, spans, final horizontal clearances, wingwall lengths, extent of rock protection, etc., shall be shown using **thin** lines and **small** text. If the overall length of the bridge cannot be clearly shown on the Elevation, it shall be shown on the Plan.

A plan title shall be shown in **large** text and the scale in **small** text. The direction and location of the cross-section plane and the direction of the elevation projection shall be shown by triangular symbols on the plan.

Working points, at the intersection of all centre or control lines and pier or abutment bearing centre lines shall be shown and labelled WP #1, WP #2, etc; names shall be written along all centre or control lines and the skew angle should be given, all in **small** text. In **small** text also, give stations, slopes, at least one top of pavement elevation at some well defined central point, and control line geometry, e.g. degree of curvature, azimuth, etc. If coordinates are available or obtainable, they shall be shown for TC's, SC's, PI's, etc., on the general arrangement drawing, and for WP's, on the foundation layout. In any case, they shall be shown together with stations. These coordinates may be tabulated separately to avoid congestion on the Plan.

On the approach slab the following note should appear "6000 mm approach slab with 80 mm asphalt". Rigid frame bridges and integral abutment bridges shall be detailed with 90 mm asphalt since they have no expansion joint dams, therefore the top of the approach slab and the top of the deck can be kept flush. This note shall be shown with a dimension line showing the 6000 mm dimension. The "6000 mm" shall appear above the dimension line and the remainder of the note below it.

<u>ELEVATION</u>

The elevation shall be immediately below the plan, located as if projected from it, and to the same scale. Normally the view is obtained as if by projecting the elevation parallel to pier centre lines or abutment faces onto a plane through the face of the bridge that is at the bottom of the plan, and then projecting vertically downwards to the location of the elevation. The ground lines shown therefore, shall be at the near bridge face and skew effects do not appear.

The outline appearing on the elevation, in lines of **medium** thickness, shall include barriers, an indication of railings, coping, soffit, and parts of piers, abutment faces and wingwalls that are above ground, final ground line, and preliminary grading lines (See 2.2.3.) Hidden detail lines, thin and dashed, shall show footings, piles, and other parts of piers and abutments that are buried.

A **thin** long-dashed line shall show the existing ground line. Do not show centre lines of piers and abutment bearings unless essential for a particular purpose. Dimension the overall length of the bridge, generally the total barrier wall length, the thickness of any pier shafts, and both the required and the actual minimum vertical clearances under the structure, with the location of the critical point indicated. Sometimes it is not possible to indicate this location clearly on the elevation and an indication also has to be given on the plan. Use the W.P. symbol . Print in **small** text footing top elevations, water levels, (see 2.5.4) an approximate lower pavement level, bearing types ("exp", "fixed" etc.), existing ground line designation, minimum soffit elevation for water crossings, railing type, railing anchorage required, rock protection or slope paving notes, and such other notes as are necessary. Note that elevations shall always be given to the top of footings and never to the bottom. If it is necessary to define the bottom of footing level, give the top elevation and dimension the footing depth.

A triangular numbered symbol (optional elevation title) followed by the scale shall show, by reference to the corresponding symbol on the plan, where and in what direction the view is taken.

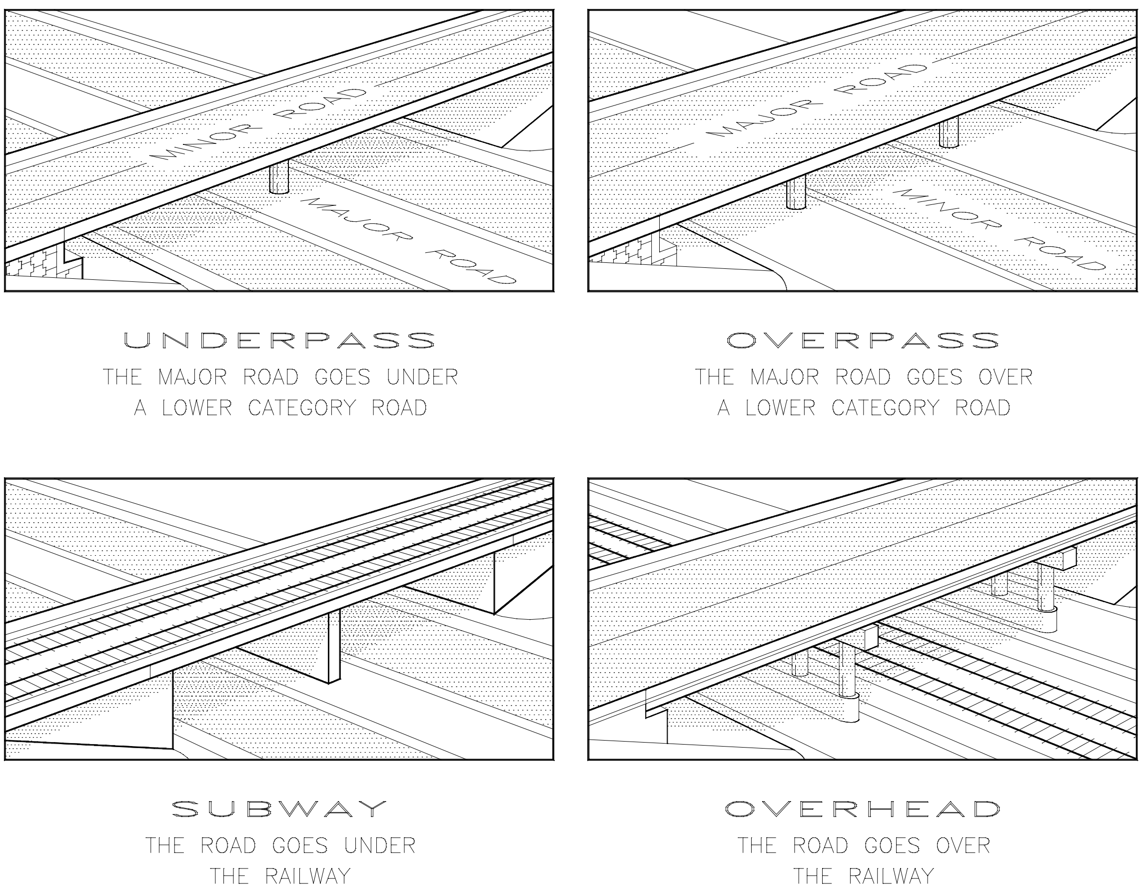


FIGURE 2.5.8(b) UNDERPASS, OVERPASS, SUBWAY AND OVERHEAD BRIDGES

CROSS-SECTION

The cross-section shall be located to the right of the Plan but may be placed elsewhere if the Plan extends across the sheet. The scale shall be 1:100 if possible. One cross-section is generally sufficient. If the cross-section varies in some way, this may be shown by giving more than one value to a dimension or taking half of the section at one point and half at another. Such a split shall be clearly shown on the plan in association with the triangular symbol and a plane of section line. If dimensions are given showing "varies," limits shall be given.

The cross-section should be shown in **medium** lines; the outline of the deck together with barrier walls, railing, wearing surface, exterior beams (others may be shown by beam centre lines), pier cap, pier shaft or columns, typical drainage outlet if any, and utilities.

Centre lines and control lines in **thin** lines shall be shown and labelled with **small** text.

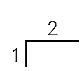
Dimensions shall be given showing overall cross-section width, distances between centre lines, curb or median widths, barrier wall face to outer deck edge width, slab thickness, pier shaft width or column diameter and the lane and shoulder widths even if there is no physical demarcation between them. Beam spacing shall be covered by a note stating the number, type and spacing of the beams.

The following note shall be given, where applicable, with an arrow pointing to the wearing surface:

"ASPHALT AND WATERPROOFING SYSTEM, 90 mm TOTAL".

No title shall be used, but a triangular symbol, numbered to agree with the one showing the section plane on the plan. This shall appear beneath the Cross-Section, followed by the scale in **small** text. The direction of the cross-section shall be indicated also by labelling the sides of the bridge "East", "North", etc., in **medium** text. This is unnecessary if the section is symmetrical. Notes in **small** text shall be added to show crossfall, wearing surface, number, size and type of ducts, etc. The section shall be taken looking in the direction of increasing chainage.

Crossfall and super-elevation are normally stated as a percentage, for example, 2%. Slopes for embankment slopes, curb side, backslopes and concrete slope paving shall be given by a numerical ratio X:Y, where X is the horizontal dimension and Y is the vertical dimension of a right angle triangle, the hypotenuse of which parallels the slope, for example 2:1. The use of a symbol as shown in the following example is preferable:



BENCH MARK

In the lower left corner of the drawing, give in **medium** text, the elevation of the bench mark to be used, e.g. BM 217.565 and below it in **small** text, the datum and description of the bench mark given on the E Plan (Bridge Site Plan).

GENERAL NOTES

In a column about 150 mm wide below the title block and under the title "General Notes" in **large** text, give the notes in **small** text as specified elsewhere. (2.5.7). These include Construction Notes.

LIST OF DRAWINGS

Below, or if necessary, to the left of the general notes, list vertically the number and title of all drawings forming part of the structural contract documents (see 2.5.2). This may include embedded work drawings. For reference to DD and OPSD drawings, see 2.5.10.

PROFILES

To the left of the general notes, show diagrammatically the profiles of all roadways, railroads and if available, new channel beds. Roadway profiles should be given only to top of pavement. The profile line should be a **medium** line. In **thin** lines, show tangent extensions and PI's. The location and length of the structure should be shown on the profile where appropriate. A title in **large** text is required below each profile giving the name of the profile, under which "N.T.S." should appear in **small** text. At each end of each profile, print in **medium** text, "North", "East", etc. The location of the profile (e.g. "COUNTY RD. 10") should be shown in **medium** text.

In **small** text, give PI elevations and stations, curve visibility and length and grades. Directions (e.g. "To Beaverton") at each end of the profiles are helpful and shall be given especially if the compass directions could be misinterpreted.

MISCELLANEOUS

When road, rail or water traffic is permitted under the structure during construction, construction clearances shall be shown and unless these can be clearly specified by a single dimension on the elevation, a separate diagram is necessary. If the clearances are standard, OPSD 3390.150 can be referenced. A separate final clearance diagram is always required for a railway opening and this shall show construction clearances if these are less than final clearances.

Non-standard backfill requirements shall be shown as specified in 5.5.1.

Functions of skew angles shall not be given.

Hatching shall be used where required to show a specific material (asphalt, etc.) or differences in materials (concrete, steel, etc.). In rehabilitation projects, hatching is used to indicate areas to be removed.

The signed P.Eng. stamps of the designer and checker shall appear to the left of the revision block (bottom right-side corner). P.Eng. stamps shall always be signed and dated.

PRELIMINARY VERSION OF THE GENERAL ARRANGEMENT

The preliminary version shall be the same in content and format as the general arrangement. On the preliminary version however, it is not necessary to show a drawing list, and the drawing number shall be "P1" rather than 1. The title shall be "General Arrangement".

The "Design/Check" initial block need not be completed at this stage, but the "Drawn/Check" block must be. A P.Eng. stamp is not required.

The profile shown on the preliminary version of the general arrangement drawing may in some cases be a proposal by the designer, necessary because of insufficient or excess clearance. If so, this shall be clearly noted, and some assurance that it is feasible shall be obtained by telephone before issuing the preliminary version. The note shall not appear on the final drawing.

2.5.9 SMALL SIZE STANDARD DRAWINGS

For inclusion with contract drawings, small size drawings bearing an SS number shall be added to a full-size standard drawing sheet as per section 1.1.3.

The title block of the full size drawing shall be completed. The title should be "Standard Details I" or II, (etc.). Initials are required as per section 1.1.7.

2.5.10 REFERENCING STANDARDS ON STRUCTURAL DRAWINGS

OPS drawings (OPSD) only, shall be listed on the particular drawing showing the details to which they apply. The number and title of the standard shall be listed just above the revision block under the heading "Applicable Standard Drawings".

If there is any ambiguity as to a standard's application, reference to the standard drawing shall also be made in close proximity to the affected detail.

2.5.11 DRAFTING SCALES

For Structural drawings, the following scales are acceptable:

1:20*
1:25*
1:30
1:40
1:50*
1:75*
1:100*
1:125*

Those marked with an asterisk are widely used in other highway design work and are preferred. In the above and what follows, it shall be understood that 1:20 legitimises 1:2, 1:200, etc.

In addition, the following may be used to avoid detail views on drawing that are excessively large or small. They may only be used in such cases.

1:60

1:150

2.5.12 MYLAR ORIGINALS

Sepias or darkened mylars shall not be used to form part of any contract package due to legibility concerns.

2.6.1 PROCEDURE FOR DISTRIBUTING AND FILING DRAWINGS AND CALCULATIONS

This procedure is described in Chapter 5 of the Structural Contract Handbook.

2.6.2 REVISIONS TO ORIGINAL DRAWINGS AND FILE COPIES

The following procedure shall be followed in making revisions to drawings for all structures, including culverts and sign supports.

(a) For all Structures Not Requiring Railway or Navigable Waters Approval

1. REVISIONS TO FILE COPIES BEFORE THE CONTRACT PACKAGE IS PREPARED (generally before a contract number is added to the originals).

   Revisions shall be entered in red pencil on the file copy. All revisions shall be identified by letter code in a hexagon on the file copy. Letter `A' for the first revision, `B' for the second, etc. The same symbol is to be used in the revision column. The date, initials of the drafter making the changes and a short description of the nature of the revision should also be given.

2. REVISIONS TO ORIGINALS BEFORE THE CONTRACT PACKAGE IS PREPARED

   Revisions shall be transferred onto the originals immediately. No identification is needed on the revised details. To indicate that a revision has taken place, the last letter code used on the file copy is marked on the right hand lower corner of the margin; no entry in the revision column is required.

3. REVISIONS TO FILE COPIES AFTER THE CONTRACT PACKAGE IS PREPARED (generally after a contract number is added to originals).

   Revisions at this stage may cause contractual complications. Changes that could have an effect on bid prices shall be discussed with the Regional Structural Section as early as possible. At the bidding stage, a contract addendum may be necessary. After award, a price change may require negotiation.

The revisions shall be entered in red pencil on the file copy. All revisions shall be identified by a number placed in a hexagon. In the revision column, the same symbol shall be used. The date, initials of the drafter making the changes and a short description of the nature of the revision shall also be given.

4. REVISIONS TO ORIGINALS AFTER THE CONTRACT PACKAGE IS PREPARED

   All information described in 3 above shall be transferred onto the originals as soon as possible, but originals shall not be revised during the period between advertising and award without informing the Regional Contract Review Officer.

   When originals are being revised, the Regional Structural Section shall ensure that the Regional Contract Office is informed. Eight full-size prints of all revised drawings shall be forwarded to the Regional Manager of Construction and notify the Contract Tendering Section of the need to issue the revised drawings to contract book holders.

(b) <u>For All Railway Overheads and Subways, and Structures Subject to the Navigable Waterways Protection Act</u>

1. BEFORE THE FIRST SUBMISSION TO THE APPROPRIATE AUTHORITY FOR APPROVAL.

   The procedures for the revisions outlined in section (a), paragraphs 1 and 2 apply.

2. AFTER THE FIRST SUBMISSION TO THE APPROPRIATE AUTHORITY FOR APPROVAL.

   The procedures for revisions outlined in section (a), paragraphs 3 and 4 apply.

(c) <u>The Following Procedures Apply to All Revisions</u>

1. Originals shall be revised only on instruction from the Section Head responsible, who shall make certain that all required approvals have been obtained from the appropriate authorities.

2. A Bridge Office Section Head shall sign to release originals from Structural Records.

3. Each revision shall be approved by the designer by initialling in the margin to the right of the revision column of the file copy.

4. If an original has to be redrawn, the previous original and file copy shall be marked prominently "Superseded" across the drawing, dated, initialled and returned to Structural Records.

5. The revision slips (in duplicate), which may be hand written or typed, originals and file copies must be returned to Structural Records at the same time.

2.7.1 BRIDGE DECK CROSS-SECTIONS

The CHBDC, CHBDC Commentary and section D.7 of the Geometric Design Standards for Ontario Highways shall be used to determine deck cross-sections.

The Geometric Design Standards for Ontario Highways uses functional classification in establishing side clearances. The functional classification of Ontario Highways may be obtained from Highway Standard Branch Memo (HSBM) 2011-02.

On long bridges (greater than 50 m long), particularly on long-span structures where the cost per square metre is greater than the cost on short-span structures, structure widths less than desirable may be acceptable; however, economy alone shall not be the governing factor in deciding structure or clearance widths. The analysis of traffic characteristics (design speed, traffic volume, % trucks etc.,), safety features, operating and emergency contingencies, and cost benefit ratios shall be considered before the desirable structure width is compromised.

In deciding the bridge deck cross-section, and determining the dimensions, location, and design of the structure as a whole, the designer shall aim to provide a bridge on which driver reaction and vehicle placement will be essentially the same as elsewhere on the highway. The resulting width shall be of proportionate value to its usefulness and safety.

2.7.2 HORIZONTAL CLEAR ZONE WIDTH REQUIREMENTS AT BRIDGE SUBSTRUCTURES

This subsection gives direction in setting the ministry's clear zone width requirements to bridge abutments and piers.

For the purpose of this subsection the following definitions apply:

Auxiliary Lane	A lane in addition to, and placed adjacent to, a through lane intended for a specific manoeuvre such as turning, merging, diverging, weaving, and for slow vehicles, but not for parking.
Clear Zone	The total roadside border area, starting at the edge of the travelled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent upon traffic volumes and speed, and on the roadside geometry.
Clear Zone Width	The distance from the edge of the travelled way to the face of an unprotected hazard.
Freeway	A fully controlled access road limited to through traffic, with access through interchanges.

Gore area	Area between the through travelled way, edge of ramp and bullnose.
Travelled Way	That part of a roadway intended for vehicular use, excluding shoulders.
Through Travelled Way	That part of a roadway intended for vehicular use, excluding shoulders and auxiliary lanes.

For further information, refer to the Roadside Safety Manual.

Freeways

The minimum horizontal clear zone width from the outside edge of the ultimate through travelled way to the face of abutments or bridge piers for all bridges over freeways shall be the greater of:

(i) 10 m.
(ii) 10 m multiplied by the appropriate curve correlation factor given in the Roadside Safety Manual for the design speed and radius of the through travelled way.
(iii) Width of gore area plus width of auxiliary lane or ramp plus 7 m from the outside edge of the auxiliary lane or ramp.

For exceptions see below.

Non-Freeways

The minimum horizontal clear zone width from the outside edge of the ultimate through travelled way to the face of abutments or bridge piers for all bridges over non-freeways shall be the greater of:

(i) The clear zone width as given in the Roadside Safety Manual for the appropriate design speed for AADT ≥ 6000 and radius of the through travelled way.
(ii) Width of gore area plus width of auxiliary lane or ramp plus the clear zone width given in (i) from the outside edge of the auxiliary lane or ramp.

For exceptions see below.

Exceptions

Where the above requirements cannot be met due to constraints including those resulting from alignment, physical, environmental, and property concerns, or would lead to a cost prohibitive structure, a reduction in the minimum horizontal clear zone width may be considered with mitigation. When this occurs reasons for this deviation from the above policy shall be demonstrated and documented in the structural design report. Mitigation measures can include an approved barrier system as specified in the Roadside Safety Manual. The barrier system shall be positioned a distance in front of the abutment or pier to allow for a deflection characteristic of the barrier system. The offset from the traffic face of the barrier system to the edge of the closest travelled lane shall be the greater of the following requirements:

(i) The minimum clearance to barriers as required by the Roadside Safety Manual.
(ii) The shoulder widths on the approaches as required by the Geometric Design Standards for Ontario Highways.

Consideration shall also be given to provide greater clearances that would not increase the cost of the structure where the bridge configuration would allow it. For example when the abutment height exceeds 8 to 8.5 metres, it is sometimes less expensive to increase the span and reduce the abutment height especially when the bridge is narrow. An open abutment arrangement is more pleasing and is preferred wherever possible without an impact on cost.

Bridge abutments and slope treatments shall also be offset adequately to provide the necessary stopping sight distances.

2.7.3 TREATMENT OF SLOPES IN FRONT OF ABUTMENTS

At overpass and underpass locations where the backslope parallel to the roadway in front of the abutment is within the clear zone width and at a slope not steeper than 2H:1V, protection is not warranted provided the slope is free of obstacles and of a smoothness that allows it to be traversable. However, if the abutment is on an intersecting fill slope as shown in Fig. 2.7.3 this slope and the exposed side of the abutment may be hazardous to errant vehicles. In this case the approach grading shall be flattened and contoured to redirect errant vehicles away from the exposed side of the abutment. An example of such grading is shown in Fig. 2.7.3.

Flattening and contouring the grading on the approaches is preferred and is generally a safer and more economical practice than placing a traffic barrier in front of the abutment. A traffic barrier is also a hazard and it is closer to traffic and significantly longer than an abutment, which is not desirable.

In situations where it is not practical to contour the approaches to the abutment fill, for example at closed abutments, appropriate mitigation measures such as traffic barriers shall be considered.

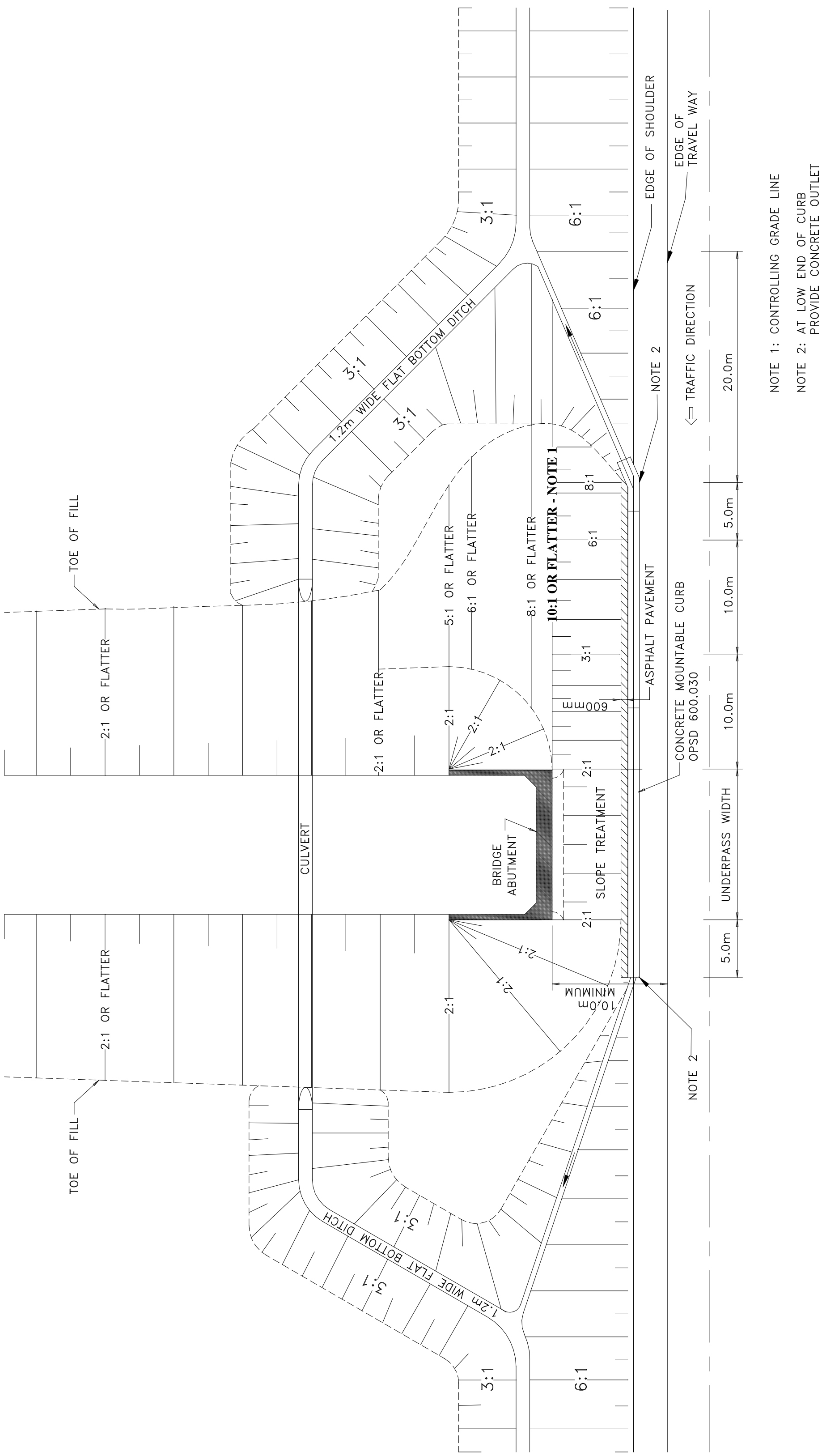


FIGURE 2.7.3 TREATMENT OF SLOPES IN FRONT OF ABUTMENTS

2.7.4 PROTECTION OF RETAINED SOIL SYSTEMS ABUTMENTS

The use of retained soil systems (RSS) for false and true abutments allows them to be constructed close to travelled lanes and in salt splash zones which exposes them to deterioration and loss of integrity in the event they are hit by errant vehicles. The RSS false abutment may also be designed as an integral or semi-integral abutment that may be vulnerable to an impact from vehicles unless it is designed to absorb the traffic load or it is adequately protected. Integral abutment bridges supported on a single row of piles are more vulnerable than semi-integral abutment bridges, which are supported on columns on rigid foundations. Consideration therefore shall be given to their protection as indicated below:

(i) Where RSS concrete facing panels are used they shall be protected by an approved traffic barrier system or a slope treatment. The slope treatment should have a 2H:1V to 2.5H:1V upward slope for a distance of at least 4.0 m measured horizontally from the edge of shoulder to the face of panels and the approach grading should be flattened and contoured as described in the previous section.

(ii) Where integral or semi integral abutment design is used the abutments should be protected as in (i) or designed for impact load.

(iii) The approved traffic barrier system should be installed at the following minimum distances to the front face of the abutment wall:

   (a) 1.5 m from the front face of a steel beam guiderail.
   (b) 1 m from the toe of the back face of a concrete barrier.

2.7.5 CLEARANCES FOR N.W.P.A. STRUCTURES

For structures over navigable waterways, the minimum clearance provided above the appropriate water level and as specified in the structural design report shall be shown on the preliminary and final versions of the general arrangement.

This minimum clearance shall be assumed to apply during as well as after construction unless the drawings indicate otherwise. If a lesser clearance during construction has been approved, it must be shown as the "Construction" clearance. This construction clearance should be given in the structural planning report or be covered by subsequent correspondence.

2.7.6 VERTICAL CLEARANCE OVER HIGHWAYS

Vertical clearances for structures are prescribed in the Ministry publication "Geometric Design Standards for Ontario Highways." Possible reduction of vertical clearance, due to settlement of an overpass structure, shall be investigated. If the expected settlement exceeds 25 mm, it shall be added to the specified clearance.

The determination of a new structure's profile shall also take into account required falsework clearances and falsework depth. Table 2.7.6 lists typical falsework dimensions for various lane arrangements.

TABLE 2.7.6

Req'd Opening	2 lanes		3 lanes	
Steel beam depth	24 in. / 610 mm		36 in. / 915 mm	
Joist depth (mm)	90	140	90	140
Plywood (mm)	17	17	17	17
Crossfall + camber (mm)	150	150	150	150
TOTAL (mm)	867	917	1172	1222

Existing structures with a clearance of less than 4.5 m must be posted.

Resurfacing or reconstruction that reduces clearance under a structure to less than 4.5 m is not permitted. In addition, any reduction of clearance below that specified for new bridges requires Ministry approval and shall be avoided if this can be achieved at reasonable cost.

2.8.1 DURABILITY

Durability requirements for new structures, rehabilitation and replacement work shall meet the provisions of section 2 of the CHBDC except where modified by the contents of this manual.

2.8.2 CORROSION PROTECTION POLICY FOR CONCRETE BRIDGE COMPONENTS

Definitions:

Corrosion Resistant Materials: means Premium Reinforcement and HPC.

Premium Reinforcement or Premium Reinforcing: means Stainless Steel or GFRP

Normal concrete: means concrete containing no silica fume, having a rapid chloride permeability at 28 days of 2500 Coulombs or less, and having a minimum specified 28-day compressive strength up to 50 MPa and which does not include silica fume.

High Performance Concrete (HPC): means concrete containing silica fume and potentially other supplementary cementing materials, having a rapid chloride permeability at 28 days of 1000 Coulombs or less, and having a specified 28-day compressive strength greater than 40 MPa.

Stainless Steel Reinforcing: means stainless steel reinforcing bars conforming to ASTM A276 and ASTM A955M, minimum grade 500, type 316 LN or Type 2205 Duplex.

Background

Current corrosion protection strategies include the use of waterproofing membrane and Premium Reinforcement for the top of bridge decks carrying strategic highways and for all other bridge components within the splash zones as defined in Table 12.1.3 of the Structural Manual. These strategies were developed based on life-cycle financial analysis. Given the higher unit price of Premium Reinforcement, the Ministry uses it judiciously and only in those components for which a life-cycle benefit can be demonstrated.

The Ministry conducted studies on a number of decks built with epoxy-coated rebars in the early 1980's. The studies showed that the waterproofing membrane and the concrete cover were effective in minimizing the ingress of moisture and chlorides, making a service life of 75 years possible provided the waterproofing is replaced every 30 years. Studies have also shown that epoxy coated steel was not effective in providing additional corrosion protection and it is therefore no longer used by the Ministry as a corrosion protection strategy.

The Bridge Office, in conjunction with the Materials Engineering and Research Office, continues to explore new types of corrosion resistant reinforcement and corrosion protection strategies will be reviewed from time to time as new cost-effective materials are identified.

Corrosion Protection Requirements

1. Premium Reinforcing shall be used in proximity to all bridge surfaces within the splash zone. This requirement may be waived for the piers of bridges where the application of de-icing chemicals below the superstructure is minimal.

2. Normal concrete is typically used. However, when considered appropriate by the Regional Structural Section, HPC may be specified for all bridge components except the following:

   - Footings
   - Post-tensioned bridges unless approved by the Regional Structural Section
   - Precast pre-stressed concrete girders with 28-day design strength less than or equal to 50 MPa

3. All concrete decks shall be protected by an asphalt and waterproofing system.

4. For superstructure components of bridges carrying traffic volumes with an AADT of ≤ 2000, the use of Premium Reinforcing materials in Table 12.1.3 is not applicable. Durability consideration for such structures shall be according to the Low Volume Road Guidelines.

Additional Requirements for Bridges Undergoing Rehabilitation or Widening

Corrosion protection treatments in accordance with this manual shall be followed in bridge rehabilitation when the remaining life of the bridge is equal to or greater than 35 years. For less than 35 years, normal concrete and black steel shall be used.

Additional Guidelines for Rehabilitation

In addition to the requirements described above, the following policies shall be followed with respect to the application of premium corrosion protection systems in rehabilitated concrete bridges:

Concrete patch repairs: Conventional concrete or proprietary patching materials shall be used in patch repairs, depending on the size and dimensions of the repair area. HPC shall not be used in patch repairs, regardless of the remaining life of the bridge or its exposure condition.

Overlays: Two low permeability overlay options are available, silica fume concrete and latex-modified concrete, as outlined in the Structure Rehabilitation Manual. There is no “HPC” overlay option available in current MTO specifications and this shall not be specified. The current strength specification for silica fume concrete overlay is 40 MPa compressive strength at 28 days. Conventional concrete remains an option for overlays.

Bridge widening, infill sections, or partial replacements shall not use premium corrosion protection systems where there is no value in extending the life of the new section beyond that of the existing bridge. If the widened portion of the bridge is to remain in place for a 35 years or longer, the corrosion protection requirements for new bridges as specified in this manual, shall be followed.

2.8.3 GUIDANCE FOR SEISMIC IMPORTANT CATEGORIES

The seismic importance category shall be determined as follows:

(i) Lifeline bridges shall include all bridges;

a. With AADT exceeding 20,000 and (overall length exceeding 1000 m, or deck area exceeding 10,000 m^2), or

b. Identified in an economic planning exercise as structures that are vital to the integrity of the regional transportation network, the ongoing economy, and/or the security of the region and/or represents significant investment and would be time-consuming to repair, with approval of the Bridge Office.

(ii) Major-route bridges shall include all bridges;

a. Carrying Core and Feeder National Highway System bridges (see Figure 2.8.3 and Table 2.8.3), or

b. Carrying 400 series highways, or

c. Exceeding 300 m in length, or

d. Exceeding 5000 m^2 of deck area; or

e. That provide sole access to emergency vehicles and those with exceptionally long detour lengths, with the approval of the Regional Structural Section, or

f. Identified in an emergency planning exercise as being critical to an emergency response of a community, with approval of the Regional Structural Section.

(iii) Other bridges are all remaining bridges.

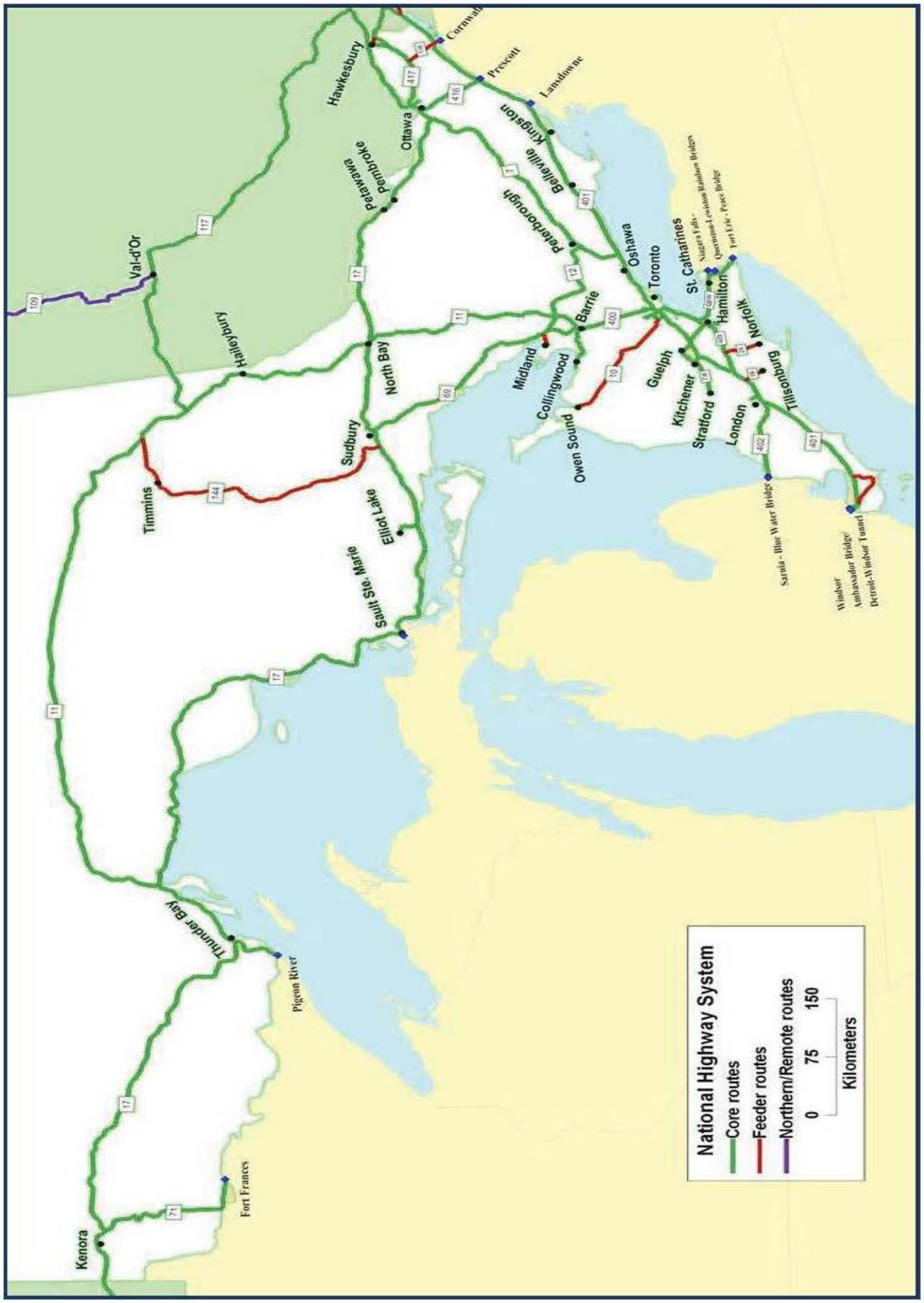


FIGURE 2.8.3 CANADA'S NATIONAL HIGHWAY SYSTEM – ONTARIO

Source: Annual Report 2012 (http://www.comt.ca/english/NHS%20Annual%202012.pdf

Ontario				Core	Feeder	Northern and Remote
Route	From	To	Length (km)	km	km	km
QEW	Fort Erie	Toronto	139.0	139.0		
401	Que. Border	Windsor	817.0	817.0		
402	London	U.S. Border (Sarnia)	103.0	103.0		
405	QEW	U.S. Border (Queenston-Lewiston Bridge)	9.0	9.0		
427	Hwy 401	QEW	8.0	8.0		
137	Highway 401	U.S. Border (Lansdowne)	4.0	4.0		
416	Ottawa (Jct. 417)	Hwy 401	76.0	76.0		
16	Hwy 401	U.S. Border (Prescott)	3.8	3.8		
417	Quebec Border	Reg. Rd 29 (Arnprior)	182.8	182.8		
400	Toronto (Jct. Hwy 401)	Parry Sound (IC-217)	210.4	210.4		
69	Parry Sound (IC-217)	Sudbury (Jct. Southwest Bypass)	181.5	181.5		
17	Reg. Rd 29 (Arnprior)	Manitoba Border	1,966.3	1,966.3		
66	Quebec Border	Kirkland Lake	58.4	58.4		
11	North Bay	Nipigon	991.5	991.5		
71	U.S. Border (Fort Frances)	Hwy 17	194.3	194.3		
61	U.S. Border (Pigeon River)	Thunder Bay (Jct. 17)	58.0	58.0		
403	QEW (Burlington)	Hwy 401 (Woodstock)	81.9	81.9		
11/400A	Barrie	North Bay	239.7	239.7		
35/115	Hwy 401	Peterborough (S Jct. Hwy 7/115)	44.8	44.8		
7/115	Peterborough (S Jct. Hwy 7/115)	Ottawa (Jct. Hwy 417)	319.0	319.0		
7/12	Peterborough (S Jct. Hwy 7/115)	Hwy 11	74.0	74.0		
12	N Jct. Hwy 11	Hwy 400	-	-		
26	Hwy 400 (Barrie)	Collingwood (County Road 19)	63.0	63.0		
06	Hwy 403 (Hamilton)	Highway 401 (Guelph)	25.9	25.9		
06	Highway 401 (Guelph)	Guelph (Woodlawn Rd.)	15.4	15.4		
07	Guelph (Woodlawn Rd.)	Kitchener (Conestoga Parkway)	20.8	20.8		
08	Kitchener (Conestoga Parkway)	Stratford (Erie)	52.5	52.5		
08	Hwy 401	Kitchener (Conestoga Parkway)	-	-		
108	Hwy 17	Elliot Lake (Hillside Dr.)	27.2	27.2		
34	Hwy 417	Hawkesbury (Quebec Border)	19.2	19.2		
17B	Hwy 17	U.S. Border (Sault Ste. Marie)	10.6	10.6		
03	Hwy 401	U.S. Border (Ambassador Bridge)	10.9	10.9		
3B	Hwy 401	U.S. Border (Detroit-Windsor Tunnel)	11.0	11.0		
420	QEW	U.S. Border (Rainbow Bridge)	4.7	4.7		
Nicholas/Rideau/King Edward	Hwy 417	Quebec Border (Gatineau)	4.0	4.0		
403	QEW	Hwy 401	20.9	20.9		
410	Hwy 401	Steeles Ave.	6.7	6.7		
427	Hwy 401	York Regional Road 7	12.1	12.1		
409	Hwy 401	Hwy 427	4.1	4.1		
6	Hwy 403	Hamilton Airport (Airport Rd.)	9.7	9.7		
Bronson/Airport Parkway	Hwy 417	Ottawa Airport	9.8	9.8		
Airport Rd./Oxford St. E	Hwy 401	London Airport	10.0	10.0		
RR7/RR50/Rutherford	Hwy 427	CP Intermodal Terminal (Vaughan)	6.0	6.0		

TABLE 2.8.3 CANADA'S NATIONAL HIGHWAY SYSTEM – ONTARIO HIGHWAYS AND LOCATIONS

Ontario (continued)				Core	Feeder	Northern and Remote
Route	From	To	Length (km)	km	km	km
Steeles/Airport Rd/Intermodal Dr.	Hwy 410 (Bovaird Dr.)	CN Intermodal Terminal (Brampton)	7.1	7.1		
Derry Rd/Airport Rd/Intermodal Dr.	Hwy 427	Steeles Ave. - CN Intermodal Terminal (Brampton)	5.6	5.6		
Gardiner Expy/Kipling/Queen	Hwy 427	CP Obico Intermodal Terminal	3.5	3.5		
Trafalgar	Hwy 401	Derry Rd. - CP Expressway Intermodal Terminal	1.7	1.7		
RR7/Keele/Administration	Hwy 400	CN RoadRailer Intermodal Terminal (Vaughan)	4.3	4.3		
McCowan Road	Hwy 401	CP Expressway Intermodal Terminal (Scarborough)	1.6	1.6		
138	Hwy 401	Hwy 417	35.4		35.4	
138	U.S. Border (Cornwall)	Hwy 401 IC	7.7		7.7	
CR17	Hawkesbury E	Hwy 417	10.0		10.0	
144/101	Hwy 17 (Sudbury)	Timmins (Mountjoy St.)	271.7		271.7	
101	Timmins (Mountjoy St.)	Highway 11	90.7		90.7	
12	Hwy 400	Midland (Highway 93)	18.0		18.0	
10	Hwy 410 (Steeles Ave.)	Owen Sound (Highway 26)	152.1		152.1	
77	Hwy 401	Leamington (Highway 3)	22.6		22.6	
03	Leamington (Hwy 77)	Hwy 401	38.7		38.7	
19	Hwy 401	Tillsonburg (Vienna Rd.)	22.5		22.5	
24	Hwy 403	Simcoe (Hwy 3/Queensway Dr.)	36.2		36.2	
		Total	6,836.3	6,130.7	705.6	-

TABLE 2.8.3 CANADA'S NATIONAL HIGHWAY SYSTEM – ONTARIO HIGHWAYS AND LOCATIONS (CONT.)

3 PILES

3.1.1 DESIGN CRITERIA

Prior to the initiation of the foundation engineering investigation, the structural Engineer shall provide the foundation Engineer with a conceptual layout of the proposed structure foundations.

The subsequent Foundation Design Report produced by the foundation Engineer may contain information and recommendations with respect to pile foundations. When pile foundations are selected, the final design shall be developed through consultation between the structural Engineer and the foundation Engineer.

In the Foundation Design Report, the foundation Engineer shall provide recommendations for:

i) type of pile

ii) axial resistances and horizontal reactions for a single pile with the provision that these values may require revision for the pile group effect once a proposed pile layout is known. They shall be given as follows:

- factored axial and horizontal resistances at ULS where the resistances are based on the geotechnical resistance of the piles

  (N.B. Factored geotechnical resistance at ULS = Ultimate geotechnical resistance x resistance factor.)

- axial and horizontal reactions at SLS* for identified settlements or displacements and corresponding subgrade reactions

  *Pile reactions at SLS should be determined from the consideration of stress/strain characteristics of the pile and unfactored geotechnical parameters of the soil appropriate to the conditions of the site.

  (N.B. Geotechnical reaction at SLS = Values calculated for specific settlement or displacement based on stress/strain performance.)

iii) depth to which the pile should be driven

iv) requirements for pile tip reinforcement to be used

v) any pile driving constraints licence

Pile resistances given in the Foundation Design Report are based on the assumption that the piles will be driven into soil that provides full lateral support against buckling. The structural Engineer may need to modify the resistances, taking into account the un-supported length of the pile, if piles are driven and left partially exposed or immersed in water.

When piles less than 5 m in length are required for pile foundations, the elastic shortening of the piles is not sufficient to distribute the loads according to the inertia method and an advanced method of analysis shall be used. Piled foundations with piles less than 3 m long are generally not economical and should not be used. In such cases, alternate foundation systems such as spread footings on compacted granular pad (engineered fill) or on mass concrete, or the use of caissons, should be investigated.

3.1.2 PILE TIP TREATMENT

The following recommendations on pile tip treatment are guidelines only and may be superseded by the foundation Engineer on a project-specific basis.

1) For piles driven to a specified elevation in soft or moderate driving conditions, no pile tip treatment is required.

2) For piles driven to end bearing on a hard material, through materials presenting only soft to moderate driving conditions and no obstructions or only minor obstructions, reinforced flanges per OPSD 3000.100 or OPSD 3001.100 respectively for H-piles or tube piles are required.

3) For piles driven to end bearing on hard material, through material presenting hard driving or obstructions such as boulders, bearing points such as the Titus ‘H’ bearing pile point or APF hard bite, standard model shall be specified.

4) For piles driven to, and seated into bedrock (usually where the angle of intersection of pile and bedrock is less than 60°), Oslo Point rock points, as per OPSD 3000.201 shall be specified and set into bedrock as detailed in the contract

3.1.3 CORROSION OF STEEL PILES

The corrosion rate of steel piles embedded in soil is influenced by a number of factors such as oxygen availability, pH, chloride content, sulphate content, sulphide ion content and soil moisture content. Measurement of these parameters can give an indication of the corrosivity of the soil; however, because of the number of factors involved and the complex nature of their interaction, actual corrosion rates cannot be determined.

In general, the corrosion behaviour of steel piles embedded in soil can be divided into two categories, corrosion in disturbed soil and corrosion in undisturbed soil. A disturbed or freshly placed soil is defined as a soil in which digging, backfilling or other soil upheaval has taken place allowing the creation of an oxygen-reach environment. Driven steel piles generally have the majority of their length in undisturbed soil; however, excavation and backfilling for footing and pile caps create a region of disturbed soil near the top of the piles, increasing the availability of oxygen and the opportunity for corrosion.

Although this may not be an issue with piles under axial compression alone, as is the case with pile groups under piers or typical abutments in bridges with joints, in integral abutments the piles are under coincident axial compression and bending and the consequences of section loss due to corrosion become much more serious.

In typical integral abutment situations, the upper three metres of the pile is encased in a corrugated steel pipe which is subsequently filled with uniformly graded loose sand. This upper part of the pile is in an oxygen rich environment and in fact, after a number of movement iterations, there is a strong probability that there may be a gap between the bottom of the concrete abutment wall and the top of the sand leaving that part of the pile completely exposed to oxygen. In addition, the pile at this location may be under the maximum coincident axial compression and bending making any section loss critical.

Consequently, design Engineers shall provide a 2-3 mm additional sacrificial thickness of steel for all steel piles in integral abutments unless the factor of safety for coincident axial compression and bending (clause 10.9.4 of CHBDC) is greater than 1.15.

For example, where HP-310x110 piles are required by design and the factor of safety is less than 1.15, the Engineer can provide an additional pile to increase the factor of safety to at least 1.15 or specify HP-310x132 or, if available, HP-310x125.

Steel piles shall not be used in corrosive ground water. Precast concrete piles may be used under these conditions, if specified with sulphate resisting cement.

3.1.4 OTHER CONSIDERATIONS

1) Refer to section 6 of the CHBDC for minimum edge distance, embedment and spacing.

2) Maximum batter for all piles is typically 1:3. The foundation Engineer must approve exceptions to this.

3) Pile driving tip reinforcement and rock points are to be used for steel piles only when specified in the Foundation Design Report (see 3.3.1). See applicable OPSD's.

4) Accessibility for pile driving equipment, allowing for batter, and any infringement on required construction clearances during driving should be considered.

5) The possibility of causing damage to buried utilities by driving piles must always be considered. Generally, if there are utilities within 3 m of piles measured at the elevation of the utility, the piles should be pre-augured to an elevation below the level of the utility.

3.2.1 STEEL H-PILES

Steel H-piles are adequately described by giving the standard steel section designation only, e.g. HP 310 x110.

Based on the successful performance of H-piles in the past, the width-thickness ratio requirement given in section 10.9.2.1 of CHBDC, ($b/t < 200/\sqrt{F_y}$), does not need to be satisfied.

The most common sizes specified in Ontario are:

HP 310 x 110

HP 310 x 132

The type of steel is specified in the standard specifications.

Splices for steel H-piles shall be according to OPSD 3000.150

3.2.2 STEEL TUBE PILES

When steel tube piles are required, the pile cross section must be specified by giving the outside diameter and the wall thickness as part of the pile data.

Steel tube piles with longitudinal or helical butt splices shall be used.

The most common sizes are:

244 mm O.D. x 13.8 mm wall thickness

406 mm O.D. x 11.1 mm wall thickness

The type of steel is specified in the standard specifications.

Splices for steel tube piles shall be according to OPSD 3001.150
.

3.2.3 WOOD PILES

When wood piles are required, the pile size must be specified as part of the pile data table by giving the following:

(i) species
(ii) minimum diameter at extreme butt or large end (mm)
(iii) minimum diameter at tip or small end (mm)

The sizes of wood piles which are normally available in Canada are given in the publication *Wood Piles* published by the Canadian Wood Council or in CAN/CSA-056 *Round Wood Piles.*

Sometimes wood piles are designated as "Size 30." Size designation in this case refers to the minimum diameter at the extreme butt or large end in centimetres i.e.

Size 30 means the minimum diameter of the pile at the large end is 30 cm or 300 mm. The most common sizes used by MTO are Size 30 and Size 36.

The document *Wood Piles* referred to above is a useful aid for the design, protection, construction and specification of wood piles in structures.

Splices in wood piles are not allowed.

Refer to section 6 of the CHBDC for restrictions concerning the use of untreated wood piles, which are less expensive than treated wood piles. Refer to 15.2.1 for treatment requirements. Where required the type of preservative treatment must be given.

The maximum length of timber piles is typically 15 m or less.

3.2.4 PRECAST CONCRETE PILES

Proprietary precast concrete piles may be used with permission of the Bridge Office Manager and the approval of the Foundation Section.

3.3.1 PILE DATA TABLE

A table or a statement entitled "Pile Data" is required on the foundation layout drawing, giving the number, lengths, batter, cross section and type of piles. The length should be the length measured along the pile between cut-off and tip elevations given or estimated by the foundation Engineer, rounded up to the nearest 0.5 m.

Pile notes are required close to the pile data table as appropriate. See also 3.3.3.

Following are typical pile notes for various conditions:

1) PILE SPACING IS MEASURED AT THE UNDERSIDE OF FOOTINGS.

2) PILE LENGTHS SHOWN ARE THE THEORETICAL LENGTHS BELOW CUT-OFF.

3) THE PILE DRIVING EQUIPMENT SHALL BE APPROPRIATE TO THE DRIVING CONDITIONS AND CAPABLE OF DELIVERING A MINIMUM SPECIFIED HAMMER ENERGY OF......kJ.

4) PILES SHALL HAVE REINFORCED TIPS AS PER OPSD 3000.100 or OPSD 3001.100 TYPE ... OR AS APPROVED *(specify if pile reinforcement is required, see also 3.1.2.)

5) PILES SHALL HAVE DRIVING SHOES AS APPROVED.

6) PILES SHALL BE FITTED WITH ROCK POINTS AS PER OPSD 3000.201. (specify if rock points are required, and if so, the type. See also 3.1.2.)

7) PILE SPLICES SHALL BE AS PER OPSD 3000.150 or OPSD 3001.150 AND IN ACCORDANCE WITH OPSS 903.

* Titus "H" Bearing Pile Points or APF Hard Bite are alternate products that are acceptable.

3.3.2 PILE DRIVING CONTROL

Pile driving control is a construction technique that is used in the field to control pile installations and thereby provide some assurance about the validity of design assumptions.

MTO's principle pile driving control tool is the Hiley formula. This is an empirical formula that models pile behaviour by relating the energy of the hammer blow to the penetration of the pile and rebound of the hammer. That is, it is a monitoring tool, not a design tool. It provides a reasonable approximation of actual pile resistance (for piles that are essentially friction-type rather than end-bearing) in non-cohesive soils, but not in cohesive soils unless the excess pore water pressures are accounted for or allowed to dissipate. Note that the hammer has to rebound enough to maintain its energy per blow and hence the soil must provide sufficient rebound for the Hiley formula to be effective.

In order to minimise misinterpretations of the Hiley formula that have occurred in practice, standard drawing SS103-11 has been revised, and renamed "Pile Driving Control." Instead of the graphical method that was used in the past, SS103-11 now gives only a calculation method to determine R, the ultimate pile capacity. The method of applying the Hiley formula, as well as some explanatory notes are given on the standard drawing, and are further elaborated here below.

When applying the Hiley formula, hammers should be operating at 100% of their available capacity. That is, for example, controls for diesel hammers should be turned to full capacity.

The formula for use with drop hammers and single-acting steam hammers is:

$$R = \frac{n\,e_f WqH}{S + \frac{C}{2}}$$

e_f = 0.75 for drop hammers

The formula for double-acting, differential-acting steam and diesel hammers is:

$$R = \frac{n\,e_f\,E}{S + \frac{C}{2}}$$

e_f = 0.6 to 0.8 for steam hammers
e_f = 1.0 for diesel hammers

Diesel hammers are currently the most commonly used type.

e_f = efficiency based on gross manufacturer's rated energy (typically 0.6 to 0.8)

H = height of free fall of mass [metres]

R = ultimate pile resistance (pile capacity) by Hiley formula [kiloNewtons]

S = measured penetration of pile per hammer blow [millimetres]

C = measured rebound of pile per hammer blow [millimetres]

E = maximum rated energy of hammer (from contractor, or tables) [Joules/blow]

n = efficiency of blow = $\frac{W + P_e^2}{W + P}$

e = coefficient of restitution
- e = 0.25 for timber pile using cushion
- e = 0.32 for steel pile using cushion
- e = 0.55 for steel pile without cushion

P = mass of components receiving blow (pile+cushion+anvil) [kilograms]

W = mass of components (ram) delivering blow (from tables) [kilograms]

g = 9.8 [metres per second^2]

(a) Design Stage

The requirement for pile design is as follows:

Factored geotechnical resistance at ULS > Design load at ULS

Factored geotechnical resistance at ULS =
Ultimate geotechnical resistance x resistance factor

Factored geotechnical resistance at ULS: given in the Geotechnical Report

Ultimate geotechnical resistance: established by geotechnical Engineer, based on formulae, field testing, or assessment

Resistance factor: the factor by which the ultimate geotechnical resistance is multiplied to establish the factored geotechnical resistance at ULS, typically 0.5.

(b) Construction Stage

The requirement for pile resistance is as follows:

Ultimate pile resistance R > Ultimate geotechnical resistance

- The **Ultimate pile resistance R** is calculated in the field by use of the Hiley formula, based on measured observations of pile penetration (S) and rebound (C), and the pile driving characteristics of energy of hammer and efficiency of blow.

- The **Ultimate geotechnical resistance** = **2 x design load at ULS**, and must be given by the designer in the pile driving notes on the contract drawings.

In the above equation:

R must be greater than **2 x design load at ULS**
(rather than **2 x factored geotechnical resistance at ULS)**

The **design load at ULS**, calculated by the structural Engineer is always less than or equal to the **factored geotechnical resistance at ULS** established by the geotechnical Engineer. The factor of 2 needs to provide safety for the actual ULS design load only, in order that the pile not be driven to an unnecessarily high capacity, risking damage during driving.

- The **design load at ULS** is the maximum factored design load per pile at the ultimate limit states, calculated by the designer.

During the process of pile driving and its monitoring, if the required ultimate pile resistance (as calculated by the Hiley formula) is not reached when expected at a prescribed elevation or in a depth of stratum bounded by prescribed elevations, the advice and recommendations of the geotechnical Engineer should be sought and followed.

It should be noted that the Hiley formula incorporates a factor to account for hammer efficiency so that the maximum rated energy should be used in the equation.

MTO's principle alternate pile driving control tool is the pile analyser which measures force imparted to the pile by measuring acceleration and/or strain of the pile in response to blows and through wave equation analysis has the potential to provide a more accurate model of pile resistance. It is used in critical applications that warrant the higher monitoring costs involved.

3.3.3 PILE DRIVING NOTES

When piles are specified, the pile driving note shall be in the form of one of the seven listed below.

When reference is made to SS103-11 (Hiley formula for steam and diesel hammers), it shall be included in with the drawings, which is usually the case unless the pile is driven to the bedrock.

Foundation Design reports are to indicate which note is applicable.

1. PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS103-11 USING AN ULTIMATE GEOTECHNICAL RESISTANCE OF .... kN PER PILE.

2. PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS103-11 USING AN ULTIMATE GEOTECHNICAL RESISTANCE OF...... kN PER PILE BUT MUST BE DRIVEN BELOW EL ....

3. PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS103-11 USING AN ULTIMATE GEOTECHNICAL RESISTANCE OF...... kN PER PILE BUT NOT BELOW EL.......... WITHOUT APPROVAL OF THE ENGINEER.

4. PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS 103-11 USING AN ULTIMATE GEOTECHNICAL RESISTANCE OF...... kN PER PILE BUT MUST BE DRIVEN BELOW EL.......... AND NOT BELOW EL....... WITHOUT APPROVAL OF THE ENGINEER.

5. PILES TO BE DRIVEN TO BEDROCK.

6. PILES TO BE FITTED WITH ROCK POINTS AND DRIVEN INTO BEDROCK IN ACCORDANCE WITH OPSS 903.

7. PILES TO BE DRIVEN TO EL ....

The ultimate geotechnical resistance, given in notes (1) to (4) to be specified = 2 x (maximum factored design load at ULS).

When using notes (5) (6) and (7), do not give ultimate resistance as part of the pile driving note.

In a separate note, headed "PILE DESIGN DATA", the maximum factored design load at the ULS and at SLS should be given and identified as such, e.g. MAX. FACTORED LOADS: ULS 1450 kN, SLS 1055 kN.

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4 FOOTINGS

4.1.1 SCOUR PROTECTION

The Hydrology Report must state what is required to provide adequate scour protection for footings.

The minimum depth of embedment in soil or soft rock, e.g., weathered shale, should be 1.2 m. This depth is provided only as a general guide for minor structures where a Hydrology Report is not considered necessary by the hydrologist and where scour is not likely to be a problem.

4.2.1 WORKING SLABS

A working slab is not considered to be a structure and shall not be shown on structure drawings.

Recommendations for working slab will be contained in the Foundation Design Report. Working slab shall be placed as recommended in the Foundation Design Report when the foundation material must be covered within a limited time after exposure to prevent deterioration. This requirement and time limit should be noted on the footing drawing.

4.3.1 FOUNDATIONS IN ROCK

Without special rock excavation procedures, over-excavation can occur. The over-excavation can result in either approximately vertical side surfaces or sloping side surfaces.

As far as the footing stability is concerned the footing will perform as intended, i.e. resistance against sliding will be provided by the approximately vertical rock surface or the rough sloping rock surface provided that:

a. In the case of over-excavation with approximately vertical side surfaces, the over-excavation is replaced with concrete of the same class as the footing concrete.

b. In the case of over-excavation with sloping (greater than about 30^{o} to the vertical) side surfaces, the sloping surfaces are rough (25 mm + deep depressions with jagged edges evenly spaced over about 50% of the sloping surface area) or if they are artificially roughened to the satisfaction of the Engineer and the over-excavation is replaced with concrete of the same class as the footing concrete.

Since OPSS 902.07 currently states that over-excavation is to be replaced by "a material suitable for the particular application and on the approval of the Engineer", it is essential that the drawings state that over-excavation of rock be replaced by concrete.

Where it is necessary to key the footings into rock the footing drawing should contain the following note:

i. Footing(s) shall be set ....mm into sound bedrock.

ii. Rock surfaces in over-excavated areas shall be subject to approval by the Engineer.

iii. Over-excavation shall be replaced with concrete of same class as footing concrete.

4.4.1 MINIMUM FROST PROTECTION TO FOOTINGS

The frost protection depth to the underside of structure footings shall be according to the recommendations of the Foundation Design Report. Where this in not available the following shall be used:

OPSD 3090.100 – Contours of frost depths for Northern Ontario

OPSD 3090.101 – Contours of frost depths for Southern Ontario

Rock fill and rock protection shall count for half of their thickness in determining the depth of cover provided.

Footings bearing on sound rock or well drained rock fill do not require frost protection; but if the rock fill is on soil, the minimum frost protection depth applies to the soil.

5 ABUTMENTS, WINGWALLS AND RETAINING WALLS

5.1.1 DESIGN OF ABUTMENTS

Beneficial effects of axial compression in flexural reinforced concrete abutment components shall be taken into account in proportioning the reinforcement whenever it is economical and practical to do so.

5.1.2 EARTH PRESSURE

Abutments and retaining walls should normally be designed for the active earth pressure. This of course is contingent on the use of free-draining granular backfill and on the type of compaction equipment used within the restricted zone behind the wall. Abutments and retaining walls founded on unyielding material or on short piles may generate earth pressures exceeding the active earth pressure.

5.2.1 ABUTMENT AND RETAINING WALL DRAINAGE

Drainage of the granular fill behind retaining walls and abutments should be provided as follows:

(a) For perched abutments - "150 mm diameter perforated subdrains" behind abutments and within the granular limits.

(b) For other types of abutments and for retaining walls - 150 mm perforated sub-drains and/or wall drains.

(c) Where there is a sidewalk in front of an abutment or retaining wall, drainage should be provided by some means (e.g. Miradrain) other than wall drains if possible.

(d) Wall drains shall be shown on the drawings by reference to OPSD 3190.100 or, if this is not appropriate, as "75 mm dia. non metallic wall drains at 3000 mm c/c, elevation to be determined by the Engineer".

The part of the above note concerning the elevation should be used only if the drain elevations are not shown on the drawings. They should be shown if possible. Generally, elevations should be set as low as possible, but at least 300 mm above the level of the ground or normal water level in front of the wall.

A pocket of "open graded 19.0 mm clear stone in accordance with OPSS 1004" should always be shown 0.05 m^3 in volume around the inlet to each drain. The drains should be shown level.

(e) Perforated subdrains must be shown on the preliminary and final versions of the general arrangement, on the elevation only. The length, outlets and connections should not be shown.

5.2.2 NEW JERSEY BARRIER PROFILE ON WALLS

When proposed abutments or retaining walls are close to travelled lanes, consideration should be given to forming a New Jersey barrier profile on the wall face. Possible applications of this treatment should be identified at the preliminary planning stage and discussed with Regional Planning & Design.

5.3.1 ABUTMENT BEARING SEATS

Bearings should be supported on concrete pedestals that are at least 50 mm above the adjacent bearing seat ledge. The concrete surface between the pedestals must slope towards the front face at 5% min. under a sealed joint and at 1 in 3 min. under an open joint. In the direction parallel to the front face, this surface should be horizontal for simplicity.

Corrosion resistant structural steel bridges require special treatment to prevent rust staining of piers and abutments. For a standard detail on piers, see section 6.3.2. For a standard detail on abutments, see Figure 5.3.1.

Except for side-by-side precast concrete box girders, all bridges having steel or concrete superstructures supported on bearings must have provision for jacking. It is feasible to jack from a 5% slope, using shims, but if the slope of the bearing seat ledge at intended jack locations is steeper, level areas must be detailed. The gap provided for jacks should be 150 mm minimum in height.

The unfactored dead load reactions (for jacking purposes) and the permissible location for jacking points should be shown on the drawings. If it is anticipated that the bridge cannot be closed for jacking, live load reactions should be included.

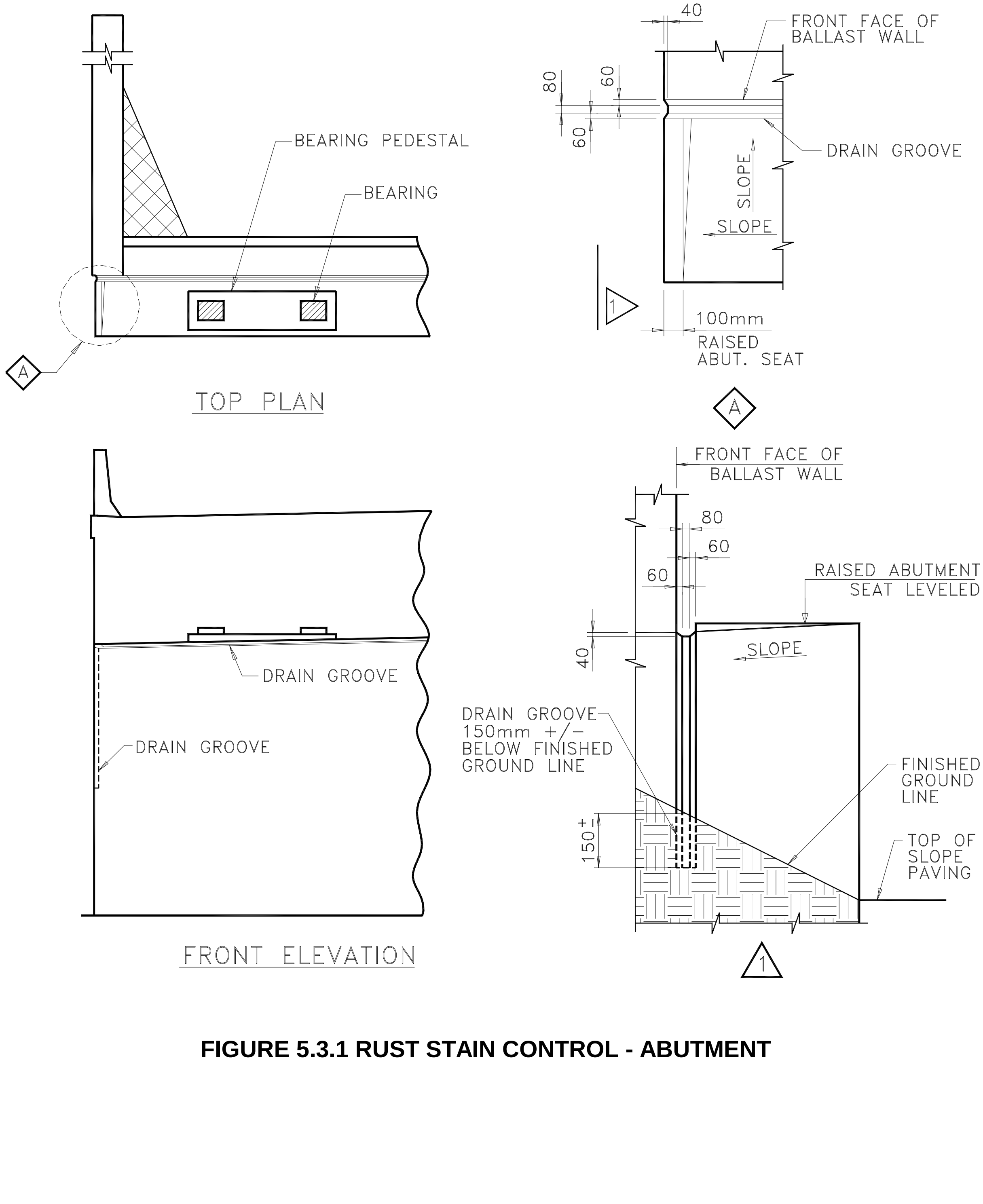

FIGURE 5.3.1 RUST STAIN CONTROL - ABUTMENT

5.3.2 ABUTMENT WALL VERTICAL CONSTRUCTION JOINTS

Relatively long and thick abutment walls are prone to cracking due to shrinkage. When the length of the abutment wall exceeds 12 m a vertical construction joint roughly in the middle of the abutment wall shall be specified. For thinner walls, as is normally the case with integral abutment bridges, engineering judgement with regard to the construction joint requirements shall be used.

5.3.3 ABUTMENT-BALLAST WALL CONSTRUCTION JOINTS

(a) For steel and precast concrete girder bridges, the horizontal construction joint between the abutment and the ballast wall should be shown level with the bearing seat. Dowels from the abutment will then project up above the bearing seat.

(b) For post-tensioned bridges, dowels may interfere with the stressing operation and the joint must generally be stepped down below the bearing seat. This may not be necessary if the anchorages are more than a lap length above the bearing seat.

5.3.4 DOWELS, ABUTMENTS TO APPROACH SLABS

It is important that the dowels used to tie approach slabs to abutment ballast walls should be in line with the bottom steel of the approach slabs. If the dowels are near the top of the slab, settlement of the slab could cause a tension crack at the top of the slab that could precipitate a shear failure with dangerous consequences. In addition, dowels should be hooked so that they do not project beyond the back face of the abutment and obstruct backfill compaction.

Abutment drawings must show a vertical dimension from the approach slab seat to the dowel. The dowels should be hooked to a diameter such that providing the correct top cover will ensure correct vertical location; a vertical leg on the other end of the dowels should be of such length that the dowels cannot be installed upside down.

The dowels provided should be size 15M @ 150.

5.3.5 BALLAST WALL DIMENSIONS AND ELEVATIONS

Ballast walls which are not more than 1200 mm high, measured above the bearing seat ledge, shall have a minimum thickness of 380 mm. For greater heights, a minimum thickness of 450 mm shall apply. It is essential however that sufficient space be available between the expansion joint armouring and the dam armouring at the top of the expansion joint. (see 13.1.1). The desirable width of the concrete dam at each side of the expansion joint is 500 mm to provide space for placing the concrete and for the bent "hairpin" rebar.

There has been some confusion regarding the calculation of elevations to be shown on the top of ballast wall on contract drawings. Standards, such as the OPSD standard for bridge deck waterproofing, show a 5 mm dimension from the top of ballast wall to the top of adjacent asphalt. The 5 mm represents a local increase in asphalt thickness to account for subsequent compaction by traffic, and should not be taken into account when calculating the elevations to be shown on the top of ballast wall on contract drawings.

5.3.6 ABUTMENT STEM THICKNESS

Requirements covering the gap between ballast walls and superstructures, and minimum ballast wall thicknesses, can lead to excessively thick abutment stems. For all except low, perched abutments, consideration should be given to corbelling the back face of the abutment in below the bearing seat ledge.

5.3.7 STAINING OF CONCRETE ABUTMENTS BY WEATHERING STEEL

Where aesthetics is important, the Regions may recommend a sealer to prevent rust staining of concrete abutments from exposed steel beams. This may occur during a prolonged delay, such as a winter shutdown, before placing the deck and expansion joints.

All exposed faces of the abutments encompassing the bearing seats, front and side faces below the bearing seat should be treated before the erection of the structural steel. Preceding the application of the sealer, surface preparation should be carried out as per manufacturer's instructions. As an alternative to a sealer, a clear curing compound may be applied after the concrete has been cured. Some rust stains may be inevitable, and provision should be made for washing the stains from the concrete after the deck has been cast.

Northern Region has successfully used "Dekguard system sealer" manufactured by Fosroc Construction Chemicals of Guelph, Ontario as a suitable sealer.

5.4.1 WINGWALLS, FROST COVER

The minimum depth of frost cover for cantilever wingwalls in well drained soil and integrally connected to abutments shall be 1.5 m. This is measured vertically from the ground surface at the end of the wingwall to the bottom of the wall. For self standing structures independent of the abutment, e.g. RSS wingwalls, the frost cover shall be as specified in section 4.4.1 for footings.

5.5.1 GRANULAR BACKFILL TO BRIDGES

The Regional Offices compute approach grading quantities prior to receiving final structure drawings and assume backfill arrangements as shown on OPSD 3101.150. If granular backfill requirements differ from those shown on the standards, they must be shown on the preliminary version of the general arrangement.

Whichever of the above standards is appropriate must always be referenced.

There is little benefit to be derived from granular backfill that cannot be drained, and it is not generally necessary to drain the back of a wall below the elevation of level soil or water in front of the wall.

5.6.1 INTEGRAL ABUTMENT BRIDGES

Integral abutment bridges are single span or multi-span bridges with a movement system composed primarily of abutments on flexible integral foundations and approach slabs, in lieu of movable deck expansion joints and bearings at abutments. The effect of the longitudinal forces in the structure due to temperature, shrinkage and creep is minimised by making the abutment foundations flexible and less resistant to longitudinal movements.

Integral abutment bridges are well suited for the concrete slab-on-girder type of superstructures for total bridge span length less than 100 m, and skew less than 20 degrees. The height of the abutment and length of wingwall should not exceed 6 m and 7 m respectively, to minimise the effect of soil pressure and resistance. The abutment should be supported on relatively flexible piles such as H-piles. Where the load-bearing strata is near the surface or where the use of short piles less than 5 m in length or the use of caissons is planned, the site is not considered suitable for integral abutment bridges.

Short span bridges have been designed with integral abutments supported on narrow spread footings capable of providing a small amount of rotation. The behaviour of the structure and its durability is greatly influenced by the movement required and detail of the footing. It is therefore restricted to structures less than 25 m in length. Alternatively, further consideration may be given to details providing a semi-integral arrangement. Semi-integral bridges are single span or multi-span continuous deck type bridges with rigid, non-integral foundations and movement system composed primarily of reinforced concrete end diaphragms, approach slabs, movable bearings and horizontal joints at the superstructure and abutment interface. This arrangement should only be considered where an integral arrangement cannot be used due to unfavourable foundation conditions.

The structure length and skew limitations can be exceeded where approved. Reference should be made to the Structural Office Report # SO-96-01, "Integral Abutment Bridges" and Bridge Office Report BO-99-03, “Semi-Integral Abutment Bridges”.

5.7.1 RETAINED SOIL SYSTEMS (RSS)

Retained soil systems (RSS) are structural systems that retain generally horizontal soil loads. They may employ either strip or grid-type, metallic or polymeric tensile reinforcements in the soil mass, and a discrete modular precast concrete facing, which is either vertical or nearly vertical. There are also other forms including interlocking soil-filled timber, reinforced concrete or steel modules.

RSS may be considered for use where conventional gravity, cantilever, or counterforted concrete retaining walls are considered, and particularly where substantial total and differential settlements are anticipated. Economic and foundation conditions determine the most suitable type for a particular location.

The contract documents should include a Foundation Investigation Report, and constraints for the retaining structure, consisting of alignment, profile, and cross-sectional space constraints. RSS are categorised in terms of three attributes, application, performance, and appearance.

- For application, the categories are: true abutment, false abutment, wall/slope, road base embankment
- For performance, the categories are: high, medium, low
- For appearance, the categories are: high, medium, low

These requirements are more fully detailed in the MTO RSS Design Guidelines.

The systems approved for use are listed in the Designated Sources for Materials (DSM) Listing, DSM #9.70.52, #9.70.53, #9.70.56 and #9.70.59. All design, construction and fabrication drawings and specifications required to complete this work are obtained by the contractor from the supplier of the proprietary RSS system listed on the DSM.

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6 PIERS

6.1.1 PIER NOSINGS FOR RIVER PIERS

Steel nosings should not be provided unless specifically called for in the Structural Design Report or in subsequent correspondence by the Head, Regional Structural Section.

6.1.2 ROUND COLUMN DIAMETERS

Most contractors rent their round column forms. Listed below are the basic series of metric sizes of round column forms generally available. Some smaller sizes are available. Special sizes may be considered only where a very large number of columns are involved.

750 mm

900 mm

1000 mm

1200 mm

1350 mm

1500 mm

1800 mm

2100 mm

2400 mm

The forms are available in modular lengths of 300, 600, 1200, 2400 and 3600 mm, except that those having diameter greater than 1200 mm are not available in 2400 mm lengths.

6.2.1 PIER BEARING SEATS

If the bridge deck over a pier is not continuous, the requirements of 5.3.1 concerning the sloping of the bearing seat ledge apply also to the pier.

The requirements of 5.3.1 concerning provision for jacking apply also to piers.

6.2.2 EXPANSION COLUMNS

Expansion columns shall be proportioned based on the appropriate shear rate when laminated elastomeric bearings are used and on a sliding coefficient of friction according to Table 11.4 of the CHBDC when pot bearings are specified.

6.3.1 COLUMN REINFORCING DETAILS IN EARTHQUAKE ZONES

Column reinforcing details in earthquake zones shall be in accordance with the provisions contained in CHBDC section 4.7.

Reinforcing details on Figure 6.3.1(a) are to be used in seismic performance category 1. They provide sufficient flexibility for the contractor and do not compromise the integrity of the column at the interface of the footing.

Figure 6.3.1(b) shows the reinforcing details to be used for seismic performance categories 2 and 3 to prevent buckling of the longitudinal steel and to provide confinement for the core of the column. A continuous spiral with continuous longitudinal reinforcement is preferable. A break in spiral at locations 1, 2 and 3 is optional. The column reinforcing should be supported during the placement of the footing, splicing of longitudinal reinforcing or spiral outside the middle half of the column is not allowed.

The spiral embedment shall be the greater of D/2 or 400 mm. The plastic hinge zone shall be the greater of H/6, D or 500 mm (see Figure 6.3.1(b)).

It is intended that details on Figures 6.3.1(a) or 6.3.1(b) be shown on the contract drawings to avoid debate during construction.

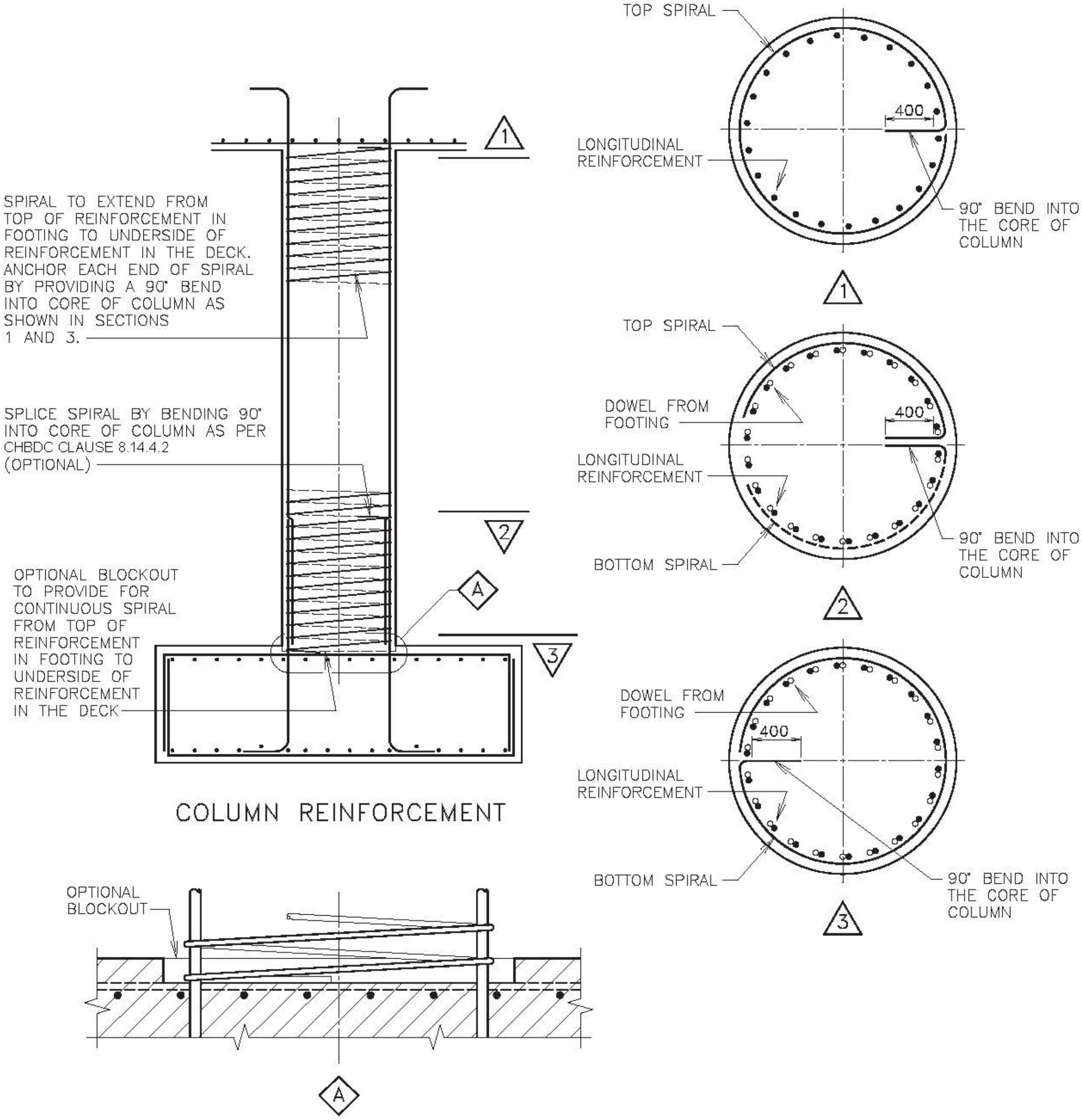

Figure 6.3.1(a) COLUMN REINFORCING DETAILS – SEISMIC PERFORMANCE CATEGORY 1

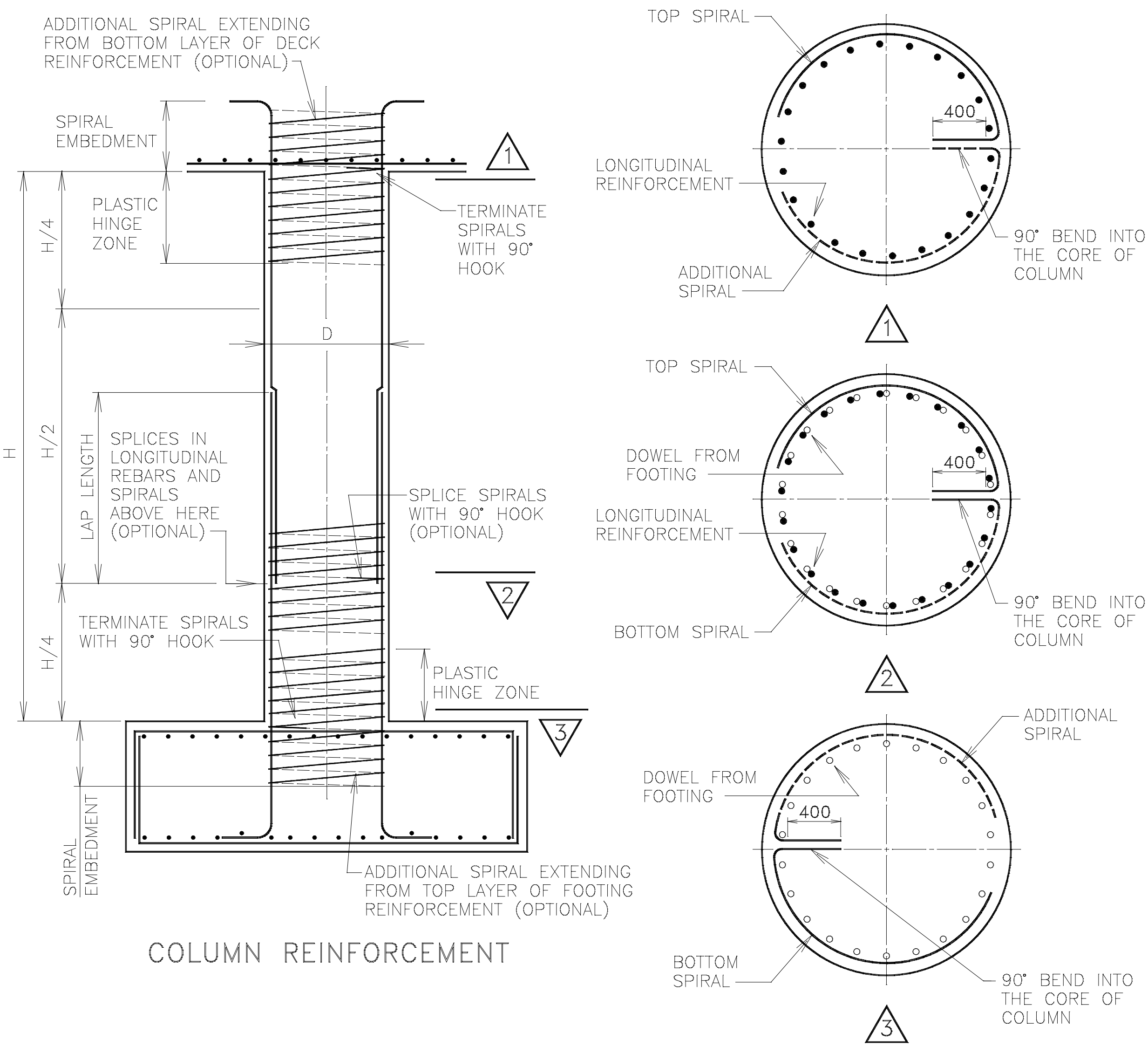

Figure 6.3.1(b) COLUMN REINFORCING DETAILS –SEISMIC PERFORMANCE CATEGORIES 2 AND 3

6.3.2 RUST STAIN CONTROL FOR STEEL GIRDER BRIDGES

Piers are to be detailed so that bearing seats are above the dams. The slope should match the deck crossfall. Add a counter slope to direct staining away from the ends. This slope should be of equal magnitude (max. 4%) but opposite direction to the deck cross-fall
.

The vertical groove should clear any radius of shaft ends by at least 300 mm in pier shafts (see Figure 6.3.2(a)) and clear the column by at least 300 mm in pier caps on columns (see Figure 6.3.2(b)). Pier shapes vary; those shown are for guidance purposes only. Place scuppers and vertical grooves at all low points. Position the scupper to take advantage of any damming action from the outside bearing seat.

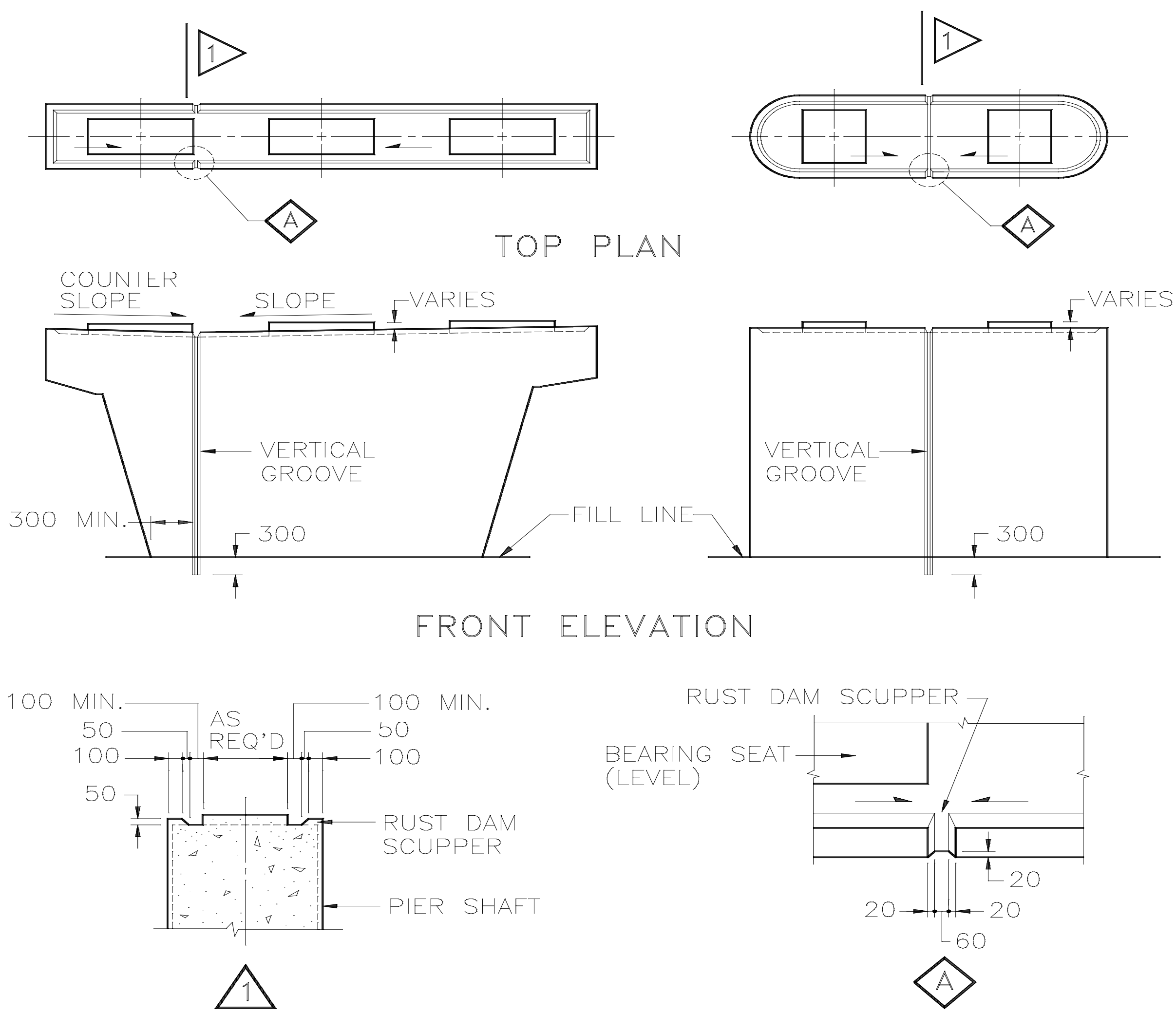

Figure 6.3.2(a) RUST STAIN CONTROL – PIER SHAFTS

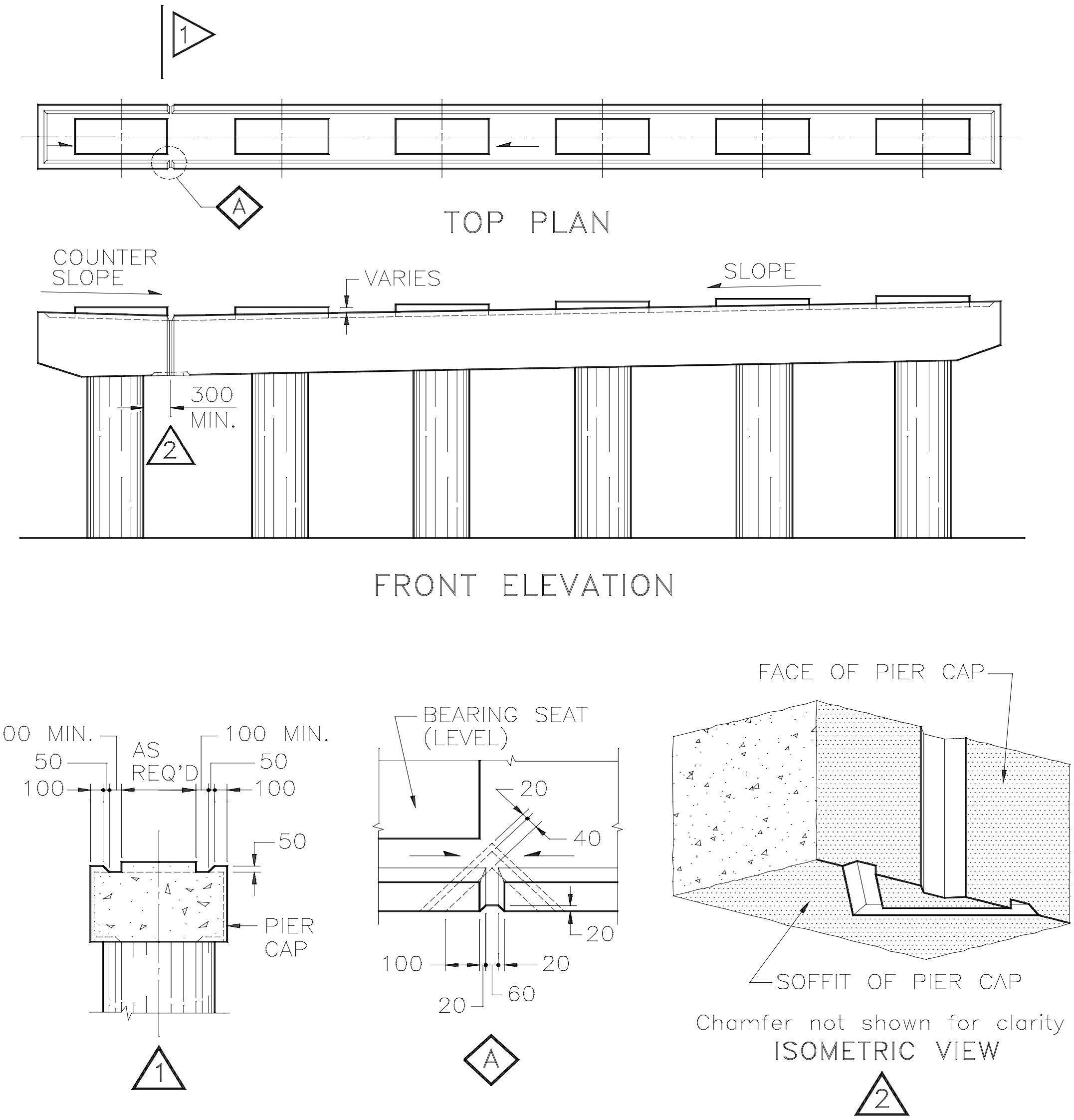

Figure 6.3.2(b) RUST STAIN CONTROL – PIER CAPS ON COLUMNS

6.3.3 PROTECTION OF BRIDGE PIER COLUMNS FROM COLLISION LOADS

New bridges shall be designed for the collision loading specified in CHBDC section 3.15.

When either lanes are added that encroach within 10m of an existing pier, or a bridge is rehabilitated where the existing lanes are already within 10m of the pier, the Regional Structural Section shall assess the structural adequacy of the pier to withstand the collision loading specified in CHBDC section 3.15. The Regional Structural Section shall consider factors including: pier vulnerability, pier structural capacity and remaining life of the bridge to determine whether strengthening of the pier and/or protection of the pier is required.

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7 PRESTRESSED CONCRETE

7.1.1 GENERAL

This section on prestressed concrete describes the requirements for pretensioned girders (7.2.1 to 7.2.6) and post-tensioned decks (7.3.1 to 7.3.11).

7.2.1 PRECAST, PRESTRESSED GIRDERS

(a) Girders should be pre-tensioned rather than post-tensioned unless transportation problems dictate post-tensioning (see 16.2.1).

(b) The design of prestressed concrete members should normally be based on a 40-50 MPa class of concrete. Higher strength concrete may be used but only where there is a definite economic advantage and availability is not a problem.

If the 28-day compressive strength required is 50 MPa or less, normal concrete should be specified in increments of 5 MPa (e.g. 40 MPa, 45 MPa.)

Where design requirements dictate the use of 28-day compressive strengths greater than 50 MPa, high performance concrete should be specified. Concrete strengths greater than 70 MPa should not be used.

Normal concrete for precast concrete girders means concrete with a specified 28-day compressive strength of 50 MPa or less and not containing silica fume. The lowest appropriate strengths should be specified, as there are increasing costs associated with increasing concrete strength. Based on past Ministry experience, girders up to and including 50 MPa compressive strength, of normal concrete, should provide adequate durability for most exposures and situations. This assumes cover requirements are met, temperature limits are observed, and other specification requirements are complied with.

High performance concrete (HPC) for precast concrete girders means concrete with a specified 28-day compressive strength greater than 50 MPa, which must include silica fume and may include other supplementary cementing materials, and having a rapid chloride permeability at 28 days of 1000 coulombs or less. There are special requirements that go along with the use of silica fume; HPC has additional requirements for curing and testing to verify that the concrete has attained the desired low permeability.

(c) It is very important for the production of precast and prestressed components that the designer specifies the minimum concrete strength at transfer, f'_{ci}, value, rounded to the nearest MPa, which the CHBDC SLS requirements will permit. The concrete strength at transfer shall preferably be such that the girder can be poured, cured and stripped on a 24-hr cycle. When transfer strengths higher than 35 MPa are required, a 24-hr cycle may not be possible. In this case it is recommended that this issue be discussed with precasters, and any effect of a longer casting cycle be considered in a cost-benefit analysis.

The designer shall ensure that the lowest allowable concrete strength at transfer, as dictated by the design, is stipulated on the drawing. The actual required concrete strength at transfer, to the nearest MPa, shall be specified using the term "Concrete Strength at Transfer......... MPa".

(d) Vertical bundling is permitted in accordance with the requirements of the CHBDC.

(e) Deflected strands must be fanned out at the ends of the beams to obtain the most uniform distribution consistent with stress requirements. The designer should keep the centroid of the deflected strands as low as design parameters will allow, while attempting to spread the strands uniformly throughout the web.

Typically precast pre-stressed girders are designed with both draped and straight strands. However, to facilitate production, all precast pre-stressed concrete box girders 800 mm deep or shallower shall be designed with straight strands only.

(f) In calculating stresses, the transformed area of the strands may be used to compute section properties.

(g) Single hold down forces greater than 80 kN (18 kips) should be avoided since this is the limit for some precasting beds. Generally, an individual strand should not be deflected steeper than at a slope of 1 to 6.

The design of CPCI girders requires a number of deflected strands, which are grouped and held down at locations near the third points of the span. Generally, strands should not be deflected steeper than a slope of 1 to 6. The maximum limit for the hold-down force that can be handled by the equipment of some precasting beds in Ontario is 80 kN.

Consequently, the designer shall ensure that the limit of 80 kN hold-down force at each hold down location is not exceeded.

To optimize the design, we have in the past specified the vertical spacing of deflected stands in the web between hold-down points as 25 mm; however, a number of precasters have equipment that cannot satisfy this spacing and they normally end up adding strands to ensure that the final required prestressing force and eccentricity are satisfied. This of course has to be approved by the designer resulting in paper work and possible delays.

At hold down locations, maintain the 50 mm vertical spacing unless the use of 25 mm spacing will result in cost savings due to the elimination of a line of girders or the use of smaller girders.

The deflected strands shall be separated into groups with the number of strands per group and the hold-down locations for each group clearly indicated on the drawings.

(h) At the ends of the girders, the strands must be located on a 50 mm x 50 mm grid with the lowest horizontal line of the grid 70 mm above the bottom of the beam and vertical grid lines 25 mm either side of the beam centre line. For deflected strands, a 100 mm vertical spacing of the grid is recommended to avoid stress concentration and hence longitudinal cracking in girder webs.

(i) The CHBDC prestressing stress limit for jacking of prestressing strands of $0.78f_{pu}$ does not account for stresses added by the fabricator to compensate for chuck sitting, form shortening, bulkhead rotations, thermal effects etc.

The precasters are very reluctant to stress the strands to $0.78f_{pu}$ plus the additional stresses require to account for the various losses indicated above due to the increased risk of breakage. This risk is even higher for draped strands. In most cases, limiting the jacking stress to $0.75f_{pu}$ will allow the precasters to safely add the required corrections.

It is also worth noting that when strands are jacked at lower ambient temperatures, the loss of prestress due to the heating of the strands when the concrete is placed can be quite significant and the corrections requires may be as high as 5%. In these cases, the correction required may bring the actual jacking stress to dangerously high levels and the precaster may be forced to utilize a lower design stress at jacking increase the number of strands. Consequently, whenever practical, it is preferred that the designer specifies a jacking stress of $0.75\ f_{pu}$.

(j) Details of the positive moment connection over piers are given on OPSD 3310.150. For the connection of the girder to the abutment, in integral abutment situations, the same details with L-shaped or hairpin bars may be used.

(k) The transition dimension for the end block of CPCI 2300A girders is 1200 mm.

(l) The supply of diaphragm dowels is shared between the precaster and the contractor. The precaster will supply the threaded inserts and corresponding diaphragm dowels for the exterior girders. The other dowels should be part of the diaphragm steel supplied by the contractor.

(m) All diaphragms shall be cast integrally with the deck slab pour, without construction joints.

(n) The standard stirrups projection above the top girder must be verified and revised if necessary, to ensure that the projection is made long enough to account for girder hogging (camber) and the vertical curve of roadway profile.

(o) Where possible, the stirrups at the ends of the girder shall have a minimum spacing of 75 mm. Particular attention shall be given to the spacing and arrangement of stirrups at the vicinity of the rectangular dowel holes. In the case of skewed bridges, a plan detailing the arrangement of the stirrups and the dowel holes shall be included on the drawings.

(p) The distance from the end of the bearing to the end of the girder shall be specified as 100 mm.

7.2.2 AVAILABILITY OF METRIC GIRDERS

The available metric girder sizes that the ministry currently uses are:

CPCI 900, 1200, 1400, 1600, 1900, 2300

CPCI 1500 is also available but supplier's are limited and therefore is not encouraged for ministry projects unless special circumstances such as vertical clearance restrictions or costs justify its use. If required the standard drawing SS107-4 for CPCI 1600 girders may be appropriately modified.

7.2.3 DEBONDED STRANDS

As it is possible for moisture to penetrate around debonded strands from the ends of girders, debonded strands shall not be used at ends of girders at expansion joints.

7.2.4 PRECAST, PRESTRESSED PLANK UNITS (SOLID AND VOIDED SECTIONS)

When used with spaces between the units, these members shall be regarded as precast girders and the deck slab shall be designed in accordance with normal composite deck slab requirements.

CHBDC section 8.21 gives requirements concerning the use of units placed side-by-side in contact.

7.2.5 TEMPORARY BRACING

To ensure that the girders are provided with adequate safety provisions during girder erection, the Ministry requires that all girders be temporarily anchored and braced as they are being erected in order to preclude detrimental movement in any direction and to prevent overturning. The precaster/erector shall brace the girders by attaching the ends of girders at each support location as indicated in the attached sketches, for the appropriate CPCI Girder.

Temporary bracing for CPCI 900, CPCI 1200 and CPCI 1400 girders shall be Type I and for CPCI 1400, CPCI 1600, CPCI 1900 and CPCI 2300 Type II. Depending on the hourly mean wind pressure, a CPCI 1400 may require Type I or Type II bracing and therefore appears in both sketches.

The sketches represent the absolute minimum bracing requirements and the precaster/erector shall determine the bracing member sizes and anchorage as well as provide additional bracing as may be required by their design.

The deck formwork designer must not rely solely on the temporary restraints provided by the pre-cast supplier for the stability of the girder. Additional or different temporary struts; bracing, tie bars/cables and other devices shall be used for temporary restraint, as required by design, in order to resist all loads imposed during each stage of construction. When working platforms are provided between the bottom flanges of the girders they should be nailed together appropriately.

Temporary struts, bracing, tie bars/cables and other devices used for temporary restraint shall be removed upon completion of the structure.

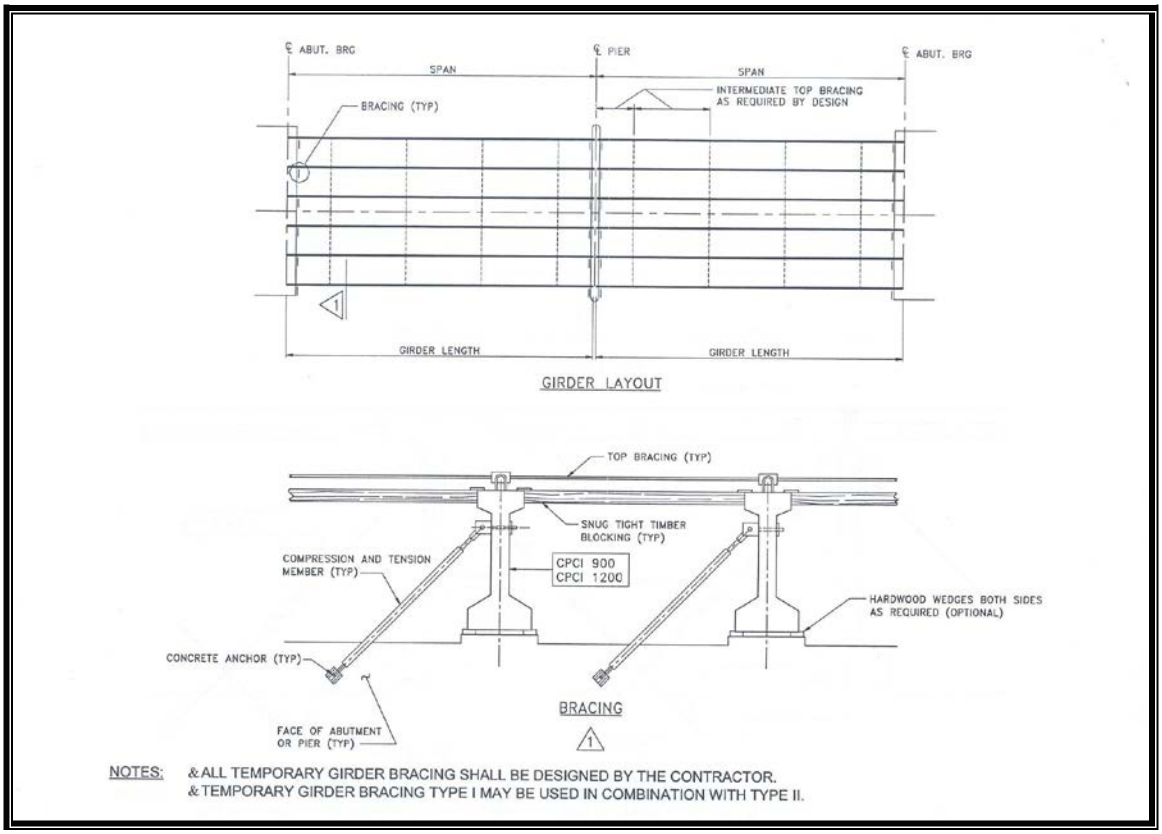


FIGURE 7.2.5(a) TEMPORARY GIRDER BRACING TYPE I

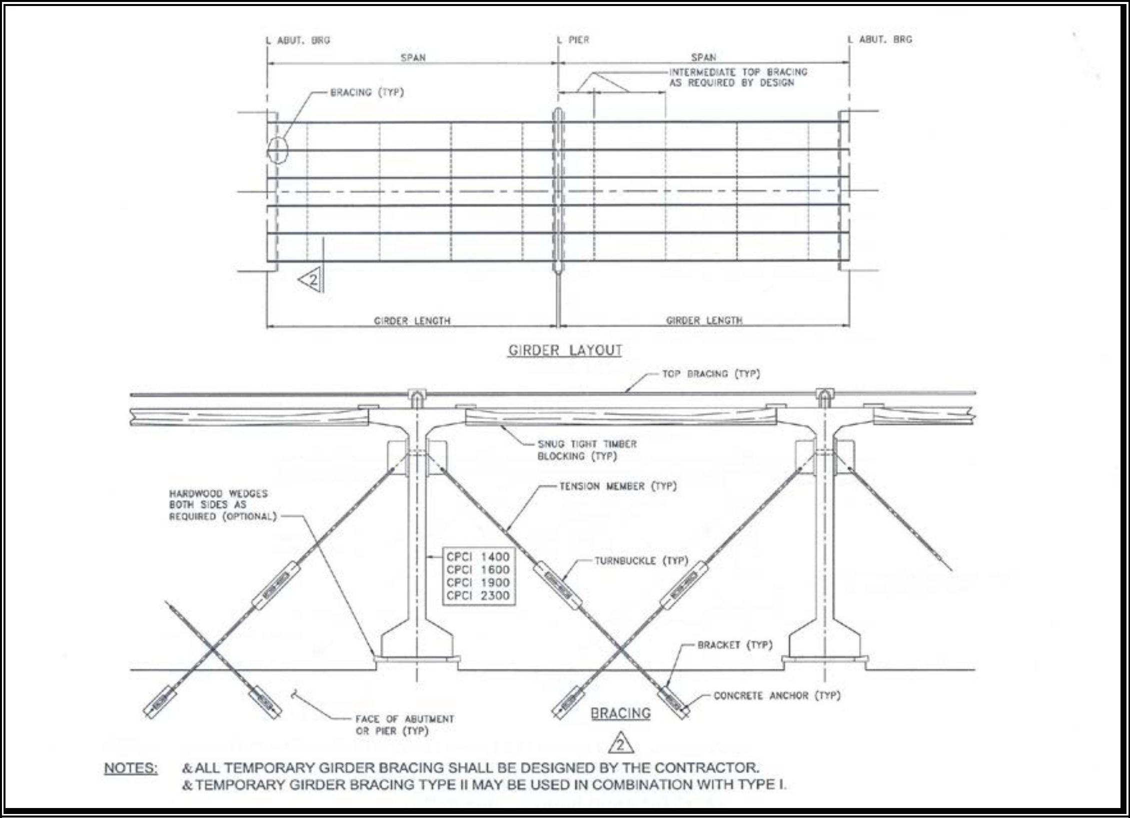


FIGURE 7.2.5(b) TEMPORARY GIRDER BRACING TYPE II

7.2.6 MULTI-BEAM DECKS

Bridge decks constructed of side-by-side precast concrete box girders with an integral structural concrete slab, do not require shear keys between adjacent girders nor transverse stressing. Such units may however require some form of temporary tying to ensure their stability during construction.

Besides the requirement for stability during construction, adjacent girders must be prevented from deflecting differentially during the pouring of the concrete deck, which would cause cracking of partially set-up concrete.

Unrestrained adjacent exterior girders will deflect differentially if they are unequally loaded during the deck pour by a large cantilever slab, or sidewalk that is detailed to be poured at the same time as the deck slab, or if the bridge is on a large skew.

Therefore, to prevent deck cracking during the deck pour of such bridges, all girders should be detailed with sufficient anchored attachments at the top of the girders that would connect adjacent girders by field welding, eliminating differential deflection.

Dimensional tolerances and slight variations in the straightness does not allow the boxes to be placed in full contact with each other when they are to be placed side-by-side. As a result the outside of exterior box to outside of exterior box dimension is usually greater than the dimension obtained by multiplying the number of boxes times the nominal width of 1220 mm.

For side-by-side box girder bridges that are designed with the 150 mm slab, this can usually be absorbed in the cantilever portion. If a cantilever does not exist, the boxes should be specified as having a width of 1220 mm and the structure should be detailed assuming that the centre-to-centre spacing will be 1225 mm.

7.2.7 ESTABLISHING SCREED ELEVATIONS

CHBDC clause 8.13.3.4 allows designers to estimate long-term deflections by multiplying instantaneous deflections by appropriate factors. These factors, or "multipliers" are given in the code commentary clause C8.13.3.

This Multipliers method originated from the Precast/Prestressed Concrete Institute (PCI) Journal article published in 1977. (*Martin, L. d., "A Rational Method for Estimating Camber and Deflection of Precast Prestressed Members", PCI Journal, V. 22 No. 1, January-February 1977, pp. 100-108)*

The method is also published in Canadian Precast prestressed Concrete Institute (CPCI) and the Precast/Prestressed Concrete Institute (PCI) documents. They do caution the reader, however, regarding the applicability of these multipliers when it comes to bridge girders where a large cast-in–place deck slab is made composite with them, as is usually the case in Ontario.

Screed elevations shall not be established using long-term deflections. The designers shall establish the screed elevations by including allowances for the profile of the roadway and the deflection due to the weight of the wet concrete slab and superimposed dead load. The deflection due to the weight of the wet concrete slab and superimposed dead load shall be multiplied by a factor of 1.10.

7.2.8 ESTABLISHING THE REQUIRED UNDERCUT AND STIRRUP PROJECTION

Although the "final" deflection multipliers specified in Table C8.8 of the commentary to the CHBDC should not be used in calculating the long-term deflections for CPCI girder type bridges (see Bridge Office Design Bulletin - Method of Establishing Screed Elevations for CPCI Girder Bridges), the actual deflections and rotations at the time of erection correlate closely to the use of the "at erection" multipliers specified in the above table of the commentary. This can be explained by the fact that, at this stage, the time dependant effects are acting on the prestressed member alone and not on the composite section. As a result the "at erection" multipliers are providing accurate predictions of deflections and rotations due to prestress and self-weight of the girder. At the erection stage, the deflections and rotations due to the weight of the wet concrete are instantaneous and do not require a multiplier (i.e. the multiplier is 1.0).

For composite action, according to the code, the stirrups must extend sufficiently into the deck to engage the bottom mat of reinforcing steel. The top of the stirrups must also be at least 100 mm below the top of the deck if black steel reinforcing bars are specified. The projection of the stirrups above the top of the girder shall be established for the erection stage. Stirrups along the length of the member can have different projections lengths specified when required by the design.

The purpose of the bearing soffit undercut is to ensure proper contact between the girder and the elastomeric bearing when all the dead loads have been applied. In calculating the undercut, the structure grade '**G**', camber due to prestress '**C**' as well as deflections due to the girder self weight and the wet concrete '**D**' should be considered (camber and deflections in this case refer to the resulting rotations). At the low end dimension '**b**' shown on the standard structural drawing SS 117-X is a function of **+G-D+C**. At the high end dimension '**c**' shown on the standard structural drawings SS 117-X is a function of **-G-D+C**. Therefore '**b**' and '**c**' may differ.

The maximum undercut dimension ('**b**' or '**c**') that is allowed, in order to maintain proper cover to the reinforcing steel, is 18 mm. When the undercut dimensions '**b**' or '**c**' exceed 18 mm, the embedded bearing plate detail shown on the MTO Standard drawings should be used.

<u>Requirements</u>

1. The multipliers specified in Table C8.8 of the commentary to the CHBDC shall be used when calculating the deflections and rotations for the girder erection stage.

2. The projection of the stirrups above the top of the girder shall be established for the erection stage. Stirrups along the length of the member can have different projection lengths specified when required by the design.

3. The bearing soffit undercut shall be established using the "at erection" multipliers when calculating the rotations due to prestress and girder self weight and a multiplier of 1.0 when calculating the rotation due to the weight of the wet concrete.

7.2.9 PRETENSIONED GIRDER NOTES

Precast beams are generally detailed on standard drawings which have the notes pre-printed. If standard drawings cannot be used, copy the appropriate notes from them.

NOTES (on DECK DETAILS drawing, prestressed girder superstructure)

1. SCREED ELEVATIONS ARE TO TOP OF CONCRETE DECK.

2. SCREED ELEVATIONS SHOWN IN TABLE INCLUDE AN ALLOWANCE FOR VERTICAL CURVE, WEIGHT OF DECK SLAB AND SUPERIMPOSED DEAD LOAD.

3. CONCRETE IN DECK SLABS AND DIAPHRAGMS SHALL BE RETARDED USING A TYPE B OR D ADMIXTURE TO ENSURE THAT THE CONCRETE REMAINS PLASTIC FOR THE DURATION OF EACH PLACEMENT.

4. CONCRETE IN BARRIER WALLS OR SIDEWALK SHALL NOT BE PLACED UNTIL ALL CONCRETE IN DECK SLAB HAS REACHED A STRENGTH OF 20 MPA.

5. FALSEWORK FOR THE CANTILEVER PORTIONS OF THE DECK SLAB (FOR A LENGTH OF 2.0 m) SHALL NOT BE REMOVED UNTIL THE CONCRETE AROUND THE INSTALLED EXPANSION JOINT HAS REACHED A STRENGTH OF 20 MPa (TYP. AT ALL FOUR CORNERS OF THE BRIDGE).

6. ALL DIAPHRAGMS SHALL BE CAST INTEGRAL WITH DECK SLAB, AND CONCRETE IN DIAPHRAGMS SHALL BE VIBRATED THOROUGHLY.

7.3.1 POST-TENSIONED DECKS

a. Post-tensioned superstructures, which are solid or are voided by means of round tubes, must be transversely prestressed throughout their length with reinforcing steel reduced to a minimum. Transverse stressing is not mandatory for box section decks except as required by (d) below.

b. Span/depth ratios shall not exceed 28.

c. For skew angles in excess of 20^o, transverse cables and reinforcement should be square to the deck except for capping beam prestress over skewed supports.

d. Transverse moments over piers and abutments shall be resisted by transverse prestressing rather than reinforcing steel.

e. The length of the solid section at the anchorages shall be at least equal to the distance from the centreline of the outside anchorage to the edge of the deck measured perpendicular to the longitudinal centreline of the deck.

f. The minimum clear cover to round voids from the top of the deck shall be 180 mm, and from the bottom, 125 mm. The recommended clear covers are 200 mm and 150 mm respectively.

g. There shall be no tension in the top surface of deck slabs in the direction of prestress except as permitted by the CHBDC.

h. The final average longitudinal prestress after all losses shall not exceed 6.5 MPa at any cross-section in round voided slabs. The minimum average effective transverse prestress over the voids, after losses but without applied loads i.e. without D.L., L.L., etc., shall be 4.5 MPa.

i. Post-tensioned decks shall be designed using 35 MPa concrete except in areas of the Province where 35 MPa concrete is not readily available. In these areas, reduced strengths shall be as specified in the Bridge Planning Report.

j. Wide bridges, where the length of any span is less than 1.5 times the width of the deck, and bridges having a skew of more than 25 degrees shall be designed using an approved analytical method.

k. The location of the outlets for cable duct vents should not be shown on the drawings.

l. The location and limits of construction joints in box girders (e.g. between slabs and webs) shall be clearly defined. This often requires that the joints be shown in plan or elevation as well as in cross section.

m. Chamfer strips shall be detailed around the perimeter of the concrete that constitutes the bottom slab of rectangular voided post-tensioned decks.

n. In order to limit and contain spalling-type stresses, resulting from the shear caused by bearing reactions, the distance from deck end to centreline of bearing shall in no case be less than 700 mm, and shall preferably be a minimum of 800 mm. This end distance for longitudinal cables may need to be even greater, depending on skew of bridge, size of tendon and size of bearing.

o. Dead-end and live-end anchorages (local zone components such as anchorage plates, spirals, bond length, anchorage bulb dimensions and bulb spacings, etc) that are adequate for the tendon force are to be fully detailed and supplied by the post-tensioning supplier. The method of providing support for the dead-end anchorages is also the responsibility of the post-tensioning subcontractor.

p. Whenever possible, the cantilever portion of cast-in-place, post-tensioned cross-sections shall be 2100 mm measured horizontally. Where economically justifiable, this dimension may be reduced in 100 mm increments down to 1600 mm.

q. The spacing of stirrups should be such that, wherever possible, a stirrup or row of stirrups is located at each tendon ordinate location.

r. Stockpiled projects which do not meet the above requirements are to be referred to the Bridge Office Manager by the appropriate Section Head in time to permit redesign.

7.3.2 SPAN TO DEPTH RATIO FOR CIRCULAR VOIDED DECKS

The following table provides recommended structure span/depth ratio for prestressed concrete circular voided decks.

Span Range (m)	Structure Depth (mm)	Void Size (mm)	Span/Depth Ratio
*28.5-30.5	1150	800	24.8-26.5
31-33	1250	900	24.8-26.4
33.5-35.5	1350	1000	24.8-26.3
36-38	1450	1100	24.8-26.2
38.5-40.5	1550	1200	24.8-26.1
**41-43	1650	1300	24.8-26.1

Notes:

(*) Solid section may be more appropriate in this range.

(**) Rectangular voided section may be more appropriate in this range.

This table is based on the recommended 150 mm cover to bottom of void and 200 mm cover to top of void. Where deck widening is expected the cover to the top of the void may be increased.

7.3.3 ROUND VOID FORMS IN DECKS

Corrugated metal pipe void forms shall be used to form all round voids.

Corrugated metal pipe is available in any size over 150 mm diameter; but the following standard diameters should be used in specifying the void sizes:

Diameter mm	**Diameter mm**
300	800
400	900
450	1000
500	1200
600	1400
700	1500

Round voids larger than 1200 mm may be used in special cases with Structural Office approval. 1100 mm and 1300 mm voids may be used if savings are significant.

The updating of stockpiled projects to comply with the above size requirements is not obligatory; but it should be considered, particularly if other substantial design changes are required.

Void forms and longitudinal reinforcing cables, etc., must be arranged so as to provide between all void forms at least one unobstructed vertical passage 100 mm or more in width as recommended in the CHBDC commentary to section 8.

Standard drawings showing void drainage, hold-down details and grout vents must be used or referenced. Stirrups should be shaped so that void forms can be lowered into place after the longitudinal cables have been placed.

7.3.4 BOX GIRDER VOIDS AND ACCESS LOCATIONS

CHBDC clause 1.8.3.1.5 requires access openings for the inspection and maintenance of concrete box sections having inside vertical dimensions of 1.20 m or greater.

Box girders with access openings shall have a minimum inside clear height of 1200 mm. The minimum clearance for walking through intermediate cross bracing and diaphragms inside box girders shall be preferably 600 mm and not less than 500 mm.

The number of access openings and their locations shall be as follows:

a) For cast-in-place concrete box girders with solid diaphragms: One opening per box cell.

b) For precast concrete box girders and segmental box girders with walk-through diaphragms: Two openings per box girder, one located adjacent to each end diaphragm.

The access openings shall be located to avoid or minimise interference with traffic during inspection and should be easily accessible to inspectors.

This policy shall apply to all current and future designs, and wherever possible, to stockpiled designs.

7.3.5 POST-TENSIONING TENDONS, DUCTS, STRANDS, DETAILING AND FRICTION FACTORS

When a strand with a breaking strength of 260.6 kN is required, Grade 1860, Size Designation 15 or 0.60" diameter strand should be specified. The nominal area of size designation 15 strand is 140.0 mm^2. The main effect of revising stockpiled projects containing grade 1760, Size Designation 16 strand is the increase in elongation.

The majority of post-tensioned superstructures, whether solid slab or circular voided or trapezoidal voided, do not require tendons larger than size designation 1906. In some cases, if larger tendons are required, tendons up to size designation 2706 may be used.

Bright rigid ducts shall be detailed for the full length of all tendons in all post-tensioned concrete bridges. Rigid duct is defined for this purpose as being a steel duct having a wall thickness of not less than 0.60 mm. The radius of curvature for rigid ducts shall not be less than 9 m.

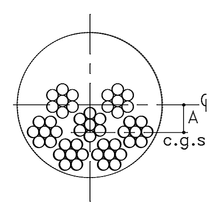
Low relaxation strand shall be utilised and specified on the drawings for all tendons. Stockpiled projects that call for stress-relieved strand or wire must be updated.

Tendons formed by merging strands from two or more ducts into one are not permitted.

7.3.6 LOCATION OF POST-TENSIONING TENDONS IN DRAPED DUCTS

After stressing, the post-tensioning tendons in curved ducts are pushed to the bottom of the duct in the negative moment areas, and to the top of the duct in the positive moment areas. The location of the tendon centre of gravity with respect to the centreline of the duct at the high and low points shall be considered in the design and may be assumed as follows:

Duct Size	A
75 mm or less	12 mm
over 75 mm to 100 mm	20 mm
over 100 mm	25 mm



7.3.7 ANCHORAGE SLIP FOR STRAND POST-TENSIONING SYSTEMS

CHBDC requires the magnitude of the anchorage slip to be either as required to control the stress in the prestressing steel at transfer, or as recommended by the manufacturer of the anchorage, whichever is greater.

The anchorage slip specified on the plans for strand post-tensioning systems shall not be less than the following values:

For anchorages with up to 7 strands ……………… 8 mm

For anchorages with 8 to 12 strands ……………..10 mm

For anchorages with more than 12 strands ……...12 mm

For Dywidag bars, the slip allowed for in design shall not be less than 1.5 mm.

7.3.8 POST-TENSIONING TENDONS AND STEEL DUCT SIZES

Standard steel duct sizes for strand post-tensioning systems are shown on Table 7.3.8. Duct diameters given are nominal and actual diameters can vary by $\pm$ 3 mm.

Table 7.3.8

No. of Tendons		Duct I.D./O.D. (mm)
13 mm strand	**15 mm strand**	
up to 7	up to 5	55/60
-	7	65/70
12	9	70/75
15	-	80/85
19	12	85/90
20	-	90/95
-	15	95/100
27	19	105/110
31	-	110/115
-	22	115/120
37	25	120/125
-	27	125/130
42	31	130/135

7.3.9 POST-TENSIONING ANCHORAGE RECESSES

Anchorage recesses should be detailed based on the largest available anchorage devices, unless special circumstances dictate otherwise.

7.3.10 POST-TENSIONING TENDON DUCT AND WEB DETAILS

Duct arrangements and corresponding reinforcement layout and web dimensions are shown in Figure 7.3.10. Dimensions are based on 110 mm O.D. sheaths.

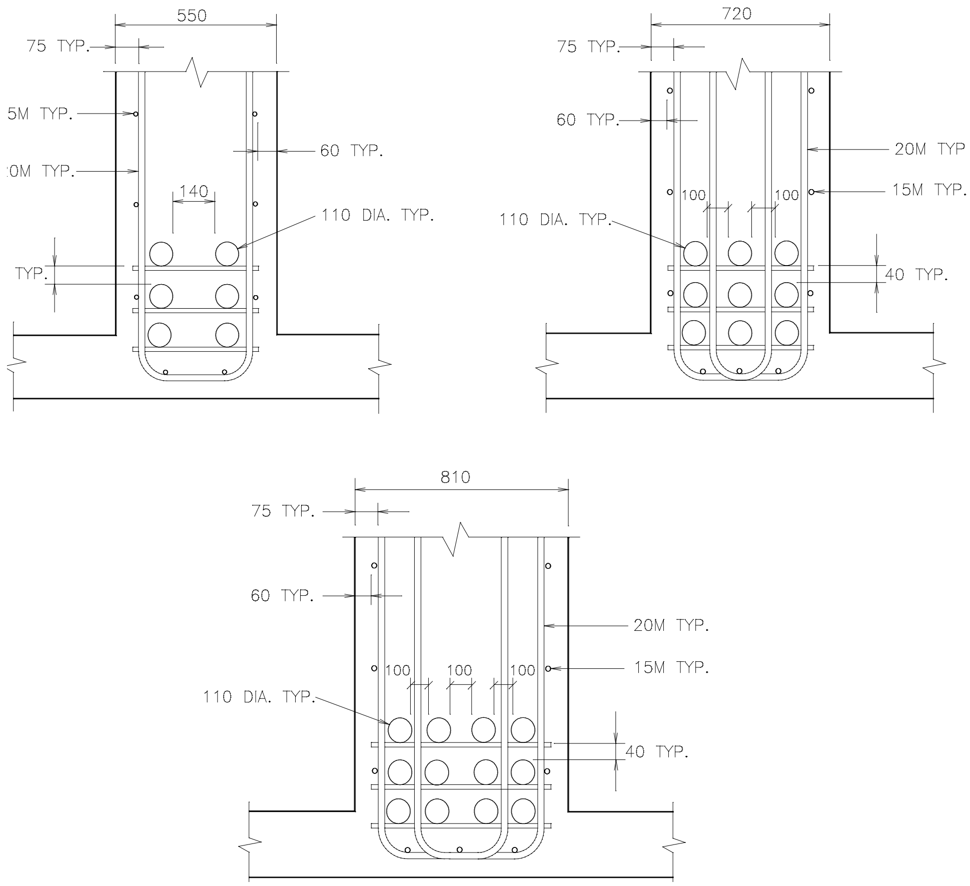


FIGURE 7.3.10(a) RECTANGULAR VOIDS

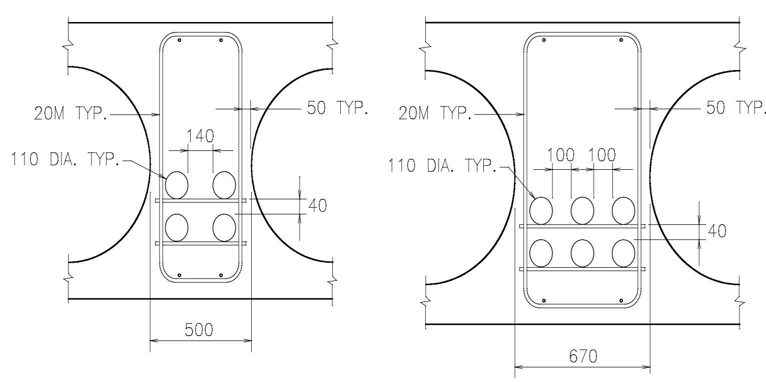


FIGURE 7.3.10(b) ROUND VOIDS

7.3.11 ADDITIONAL REINFORCING IN EXTERIOR WEBS ADJACENT TO TAPERED VOIDS

In order to prevent tendons breaking into the tapered voids, additional reinforcing is required to resist the radial forces caused by horizontally curved tendons. A detailed plan and cross-section through the tapered portion of the voided section must be shown on contract drawings (see Figure 7.3.11). No splices of duct sheathing shall be allowed along the tapered portion of void, and within one metre from either end of it, to reduce the risk of tendon kinking.

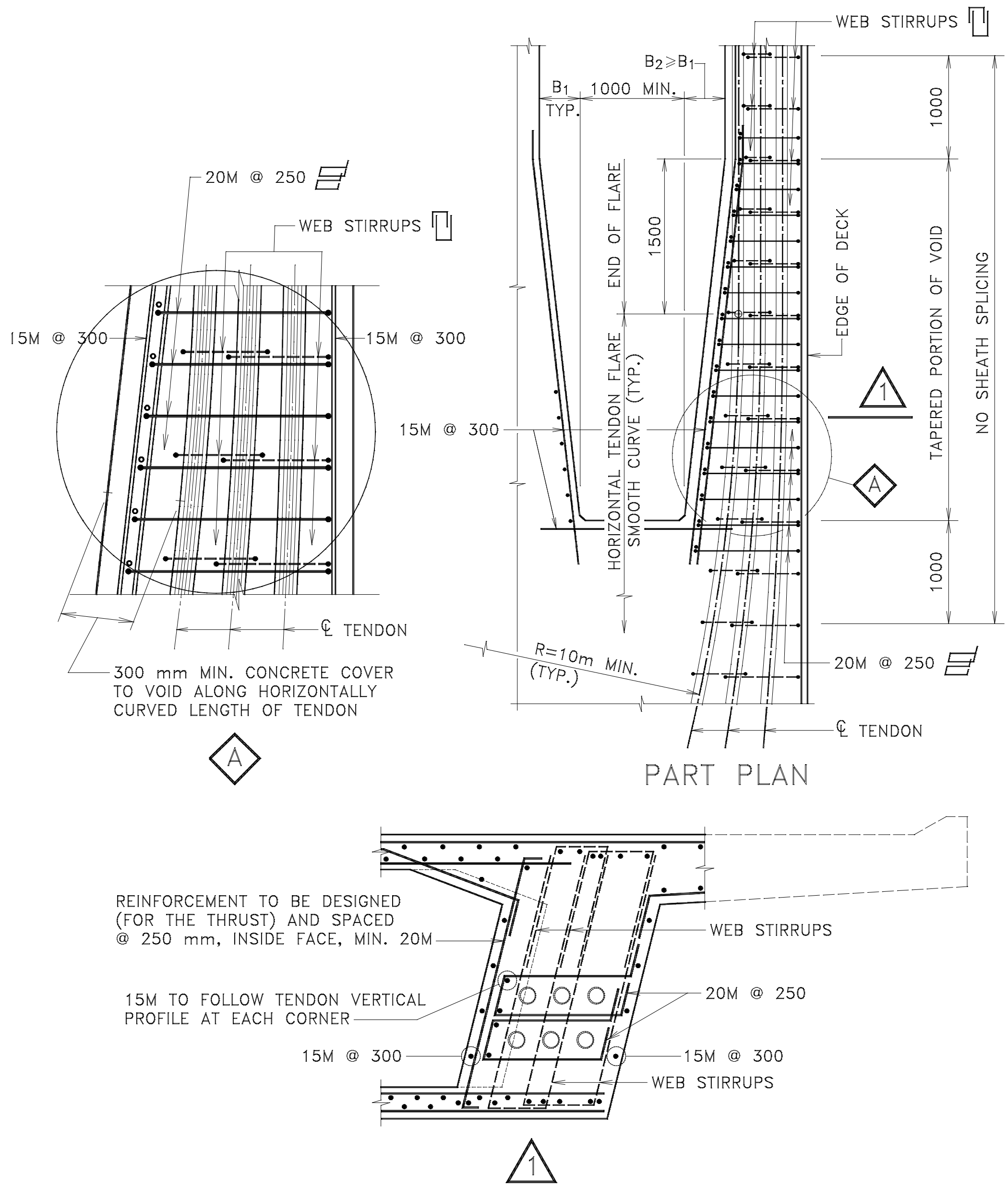


FIGURE 7.3.11 ADDITIONAL EXTERIOR WEB REINFORCING

7.3.12 POST-TENSIONED DECK NOTES

The following are standard notes of the type shown below the title block on the appropriate drawing. The notes must be worded to cover the requirements specific to the particular project and should only be used if applicable. Other notes may be required in special circumstances.

In specifying the classes of concrete, different components may be itemised together if the classes are the same. For clarity the wording of the notes is shown in upper case (capital) lettering. Explanations shown in brackets in lower case lettering are not part of the notes.

(a) GENERAL NOTES

1. ALL TENDON ANCHORAGES SHALL BE INTERNAL TYPE AS SHOWN ON THE DRAWINGS.

2. PRESTRESSING TENDONS SHALL BE B.B.R., FREYSSINET, V.S.L. OR DYWIDAG.

3. DUCT GROUTING VENTS SHALL BE PROVIDED AT HIGH POINTS AND AT BOTH ENDS OF ALL TENDONS.

4. MIN. CLEAR COVER TO TENDONS DUCTS:

   TOP .... ± .... LONGIT.

   .... ± .... TRANSV.

   ELSEWHERE .... ± ....

5. WELDING IS NOT PERMITTED WITHIN 3000 mm OF ANY TENDON OR TENDON DUCT.

6. ALL TENDONS SHALL BE STRESSED IN THE NUMERICAL ORDER SHOWN ON THE DRAWINGS.

7. CLASS OF CONCRETE: 35 MPa

8. CONCRETE STRENGTH BEFORE STRESSING ....MPa

9. ALL ANCHORAGE RECESSES SHALL BE ABRASIVE BLASTED AND COATED WITH AN APPROVED CEMENT PASTE PRIOR TO CASTING OF 35 MPa CONCRETE IN THE RECESSES AND TO BE COLOUR MATCHED WITH ADJACENT CONCRETE.

10. THE POST-TENSIONING SUPPLIER SHALL DETAIL AND SUPPLY LIVE-END SPIRAL REINFORCEMENT AND DEAD-END ANCHORAGES, INCLUDING THE METHOD OF SUPPORT AND ASSOCIATED REINFORCEMENT.

(b) LONGITUDINAL TENDONS

1. PRESTRESSING TENDONS SHALL BE TYPE .... WITH .... STRANDS.

2. PRESTRESSING STEEL SHALL BE LOW RELAXATION SEVEN WIRE STRAND, SIZE DESIGNATION ...., GRADE ...., AND SHALL MEET THE REQUIREMENTS OF ASTM A416/A416M.

3. MINIMUM BREAKING STRENGTH ....kN/STRAND

4. SHEATHS FOR POST-TENSION DUCTS SHALL BE BRIGHT STEEL, RIGID, CORRUGATED TYPE, ... mm OD WITH A MINIMUM WALL THICKNESS OF 0.6 mm OR EQUIVALENT APPROVED BY MTO.

5. REQUIRED ELONGATION AND THE TENDON JACKING FORCE SHALL BE AS SHOWN IN THE TABLE BELOW. (Use "STAGE" column in table if superstructure is staged-construction.)

   ELONGATIONS SHOWN ARE APPROXIMATE AND MAY BE ADJUSTED BY MTO AFTER THE ACTUAL STRESS-STRAIN PROPERTIES OF THE STRAND TO BE USED ARE AVAILABLE.

   ASSUMED E_p= ....MPa, K= ...., m= ....

STAGE	LOCATION	TENDON	TYPE	JACKED FROM	JACKING FORCE (kN)	ELONGATION (mm)	REQUIRED SLIP (mm)

6. DUCTS FOR PRESTRESSING STEEL SHALL BE SECURELY FASTENED IN PLACE TO PREVENT MOVEMENT UNTIL CONCRETE IS PLACED AND HARDENED. DUCTS SHALL BE SUPPORTED AT INTERVALS NOT EXCEEDING 500 mm OR AS SHOWN ON THE DRAWINGS.

(Jacking data should be given for simultaneous jacking from both ends and also for jacking at one end followed by final take-up jacking at the other).

(c) TRANSVERSE TENDONS

1. PRESTRESSING TENDONS SHALL BE TYPE .... AND .... WITH .... AND .... STRANDS RESPECTIVELY.

2. PRESTRESSING STEEL SHALL BE LOW RELAXATION SEVEN WIRE STRAND, SIZE DESIGNATION ...., GRADE ...., AND SHALL MEET THE REQUIREMENTS OF ASTM A416/A416M.

3. MINIMUM BREAKING STRENGTH ....kN/STRAND

4. SHEATHS FOR POST-TENSION DUCTS SHALL BE BRIGHT STEEL, RIGID, CORRUGATED TYPE, ... mm OD WITH A MINIMUM WALL THICKNESS OF 0.6 mm OR EQUIVALENT APPROVED BY MTO.

5. REQUIRED ELONGATION AND THE TENDON JACKING FORCE SHALL BE AS SHOWN IN THE TABLE BELOW.

   ELONGATIONS SHOWN ARE APPROXIMATE AND MAY BE ADJUSTED BY MTO AFTER THE ACTUAL STRESS-STRAIN PROPERTIES OF THE STRAND TO BE USED ARE AVAILABLE.

   ASSUMED E_p= ....MPa, K= ...., m= ....

LOCATION	TENDON	TYPE	JACKED FROM	JACKING FORCE (kN)	ELONGATIO N (mm)	REQUIRED SLIP (mm)

6. DUCTS FOR PRESTRESSING STEEL SHALL BE SECURELY FASTENED IN PLACE TO PREVENT MOVEMENT UNTIL CONCRETE IS PLACED AND HARDENED. DUCTS SHALL BE SUPPORTED AT INTERVALS NOT EXCEEDING 500 mm OR AS SHOWN ON THE DRAWINGS.

7. FOR GENERAL NOTES, SEE DWG. ....

(Jacking data should be given for simultaneous jacking from both ends and also for jacking at one end followed by final take-up jacking at the other).

(d) NOTES (on DECK DETAILS drawing, post-tensioned superstructure)

1. NO ALLOWANCE IS REQUIRED FOR DEAD LOAD DEFLECTION.

2. THE SCREED ELEVATIONS SHOWN ARE TO BE ADJUSTED FOR FALSEWORK DEFLECTION ONLY, BEFORE THEY ARE USED FOR SETTING SCREEDS.

3. ALL ELEVATIONS ARE TO TOP OF CONCRETE AS SHOWN.

(The following notes are applicable only to trapezoidal-voided post-tensioned box-girders:)

4. DRAINAGE TUBES TO BE LOCATED AT LOW POINT OF VOID CROSS-SECTION.

5. FORMWORK USED TO FORM VOIDS SHALL BE REMOVED AFTER CONCRETE STRENGTH HAS REACHED 20 MPa.

6. FOR ACCESS HATCH DETAILS, SEE DWG. ....

(The following note shall be included on the Deck Detail drawing for post-tensioned deck bridges constructed in stages:)

THE CALCULATED APPROXIMATE VERTICAL DEFLECTION BETWEEN THE TIP OF THE CANTILEVER AND SUBSEQUENT STAGE, IS AS FOLLOWS:

STAGE 1: ……….

STAGE 2: ………. etc.

THE CONTRACTOR SHALL VERIFY THE DEFLECTION AND ADJUST THE SOFFIT FORMS, AND/OR FALSEWORK, TO PROVIDE A SMOOTH TRANSITION FOR A MINIMUM DISTANCE OF 1.2 m FROM THE END OF THE PREVIOUS STAGE.

(e) SEQUENCE OF DECK CONSTRUCTION (on DECK DETAILS drawing, for solid or circular-voided post-tensioned superstructure)

1. PLACE CONCRETE IN DECK EXCEPT AT (SIDEWALKS, MEDIAN, CURBS AND BARRIER WALLS) PRESTRESSING ANCHORAGE RECESSES, AND EXPANSION JOINTS.

2. STRESS ALL TRANSVERSE TENDONS AT PIERS AND ABUTMENTS, THEN IN SPANS, WHEN CONCRETE IN DECK HAS REACHED A STRENGTH OF 30 MPa.

3. PLACE CONCRETE AT TRANSVERSE ANCHORAGE RECESSES.

4. STRESS ALL LONGITUDINAL TENDONS AFTER CONCRETE IN TRANSVERSE ANCHORAGE RECESSES HAS REACHED A STRENGTH OF 30 MPa.

5. PLACE 35 MPa CONCRETE AT RECESSES FOR ALL LONGITUDINAL TENDONS.

6. GROUT ALL TRANSVERSE AND LONGITUDINAL TENDON DUCTS.

7. PLACE CONCRETE IN SIDEWALKS, MEDIAN, CURBS AND BARRIER WALLS.

(f) SEQUENCE OF DECK CONSTRUCTION (on DECK DETAILS drawing, for trapezoidal-voided post-tensioned superstructure)

1. PLACE CONCRETE IN BOTTOM SLAB (ACCESS HATCH IN POSITION).

2. PLACE REMAINING CONCRETE IN DECK EXCEPT AT (SIDEWALKS, MEDIAN, CURBS AND BARRIER WALLS) PRESTRESSING ANCHORAGE RECESSES AND EXPANSION JOINTS.

3. STRESS ALL TRANSVERSE TENDONS AT PIER(S) AND ABUTMENTS WHEN CONCRETE IN DECK HAS REACHED A STRENGTH OF 30 MPa.

4. PLACE CONCRETE AT TRANSVERSE ANCHORAGE RECESSES.

5. STRESS ALL LONGITUDINAL TENDONS AFTER CONCRETE IN TRANSVERSE ANCHORAGE RECESSES HAS REACHED A STRENGTH OF 30 MPa.

6. PLACE 35 MPa CONCRETE AT RECESSES FOR ALL LONGITUDINAL TENDONS.

7. GROUT ALL TRANSVERSE AND LONGITUDINAL TENDON DUCTS.

8. PLACE CONCRETE IN SIDEWALKS, MEDIAN, CURBS AND BARRIER WALLS.

(The above notes apply to single-stage construction. If the deck is cast and stressed in multiple stages, the order of steps 6 and 7 should be reversed).

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8 STRUCTURAL STEEL

8.1.1 STRUCTURAL STEEL

(a) All structural steel used in highway structures shall be atmospheric corrosion resistant (ACR) steel. Steel shall conform to CSA standard G40.20/G40.21 grade 350AT or grade 350A. The Charpy impact energy requirements for fracture critical and primary tension members shall be 27 Joules and the test temperature shall be dependent on the service temperature and as specified in Table 10.12 and Table 10.13 of CSA S6.

Rolled sections shall conform to CSA Standard G40.20/G40.21 or ASTM specification A588.

(NOTE: ASTM A588 may be substituted for G40.21 grade 350A steel, and when the Charpy impact energy requirements are verified by the submission of test documentation, ASTM A588 may be substituted for G40.21 grade 350AT steel.)

(b) Section 10 of CHBDC defines primary tension members as members, or portions of members, including attachments, other than fracture-critical members and secondary components, that are subject to tensile stress. Girders and attachments fabricated from plate material shall be made from 'AT' grade steel.

(c) All primary members as well as secondary members designed for the forces they attract, as would be the case for curved or highly skewed bridges, shall be grade 350AT.

(d) Secondary members of straight bridges or bridges with a skew less than 20 degrees may be grade 350A.

(e) Secondary members of curved bridges or highly skewed bridges shall be designed for the forces they are subjected to and shall have the same Charpy impact energy and test temperature requirements as the primary members.

(f) Steel trapezoidal box girders should be used in preference to I-girders for crossings over highways because they are considered to be less likely to entrap salt and debris.

(g) The availability of the required widths and thicknesses of plate should be confirmed before finalising the design. Available lengths are sometimes of importance in relation to the positioning of field splices.

(h) Plate girders shall be specified rather than providing specific welded wide flange (WWF) and welded reduced flange (WRF) designations.

(i) Galvanized A490 bolts shall not be used.

(j) A325M bolts, Type 3, shall be used for all connections. Bolts shall be 22 mm size, except that where large numbers are required, in restricted spaces, 25 mm size may be used.

(Note: ASTM A490M Type 3 bolts may be substituted for ASTM A325M Type 3 bolts on atmospheric corrosion resistant steel, but galvanized A490 Type 1 bolts on coated steel are not permitted because of delayed fracture due to hydrogen embrittlement.)

(k) Huck bolt fasteners are acceptable if proposed as an alternative to high strength bolts by the contractor, but should not be shown as such on contract drawings.

(l) Field welding is generally not permitted. Field splices are generally bolted connections.

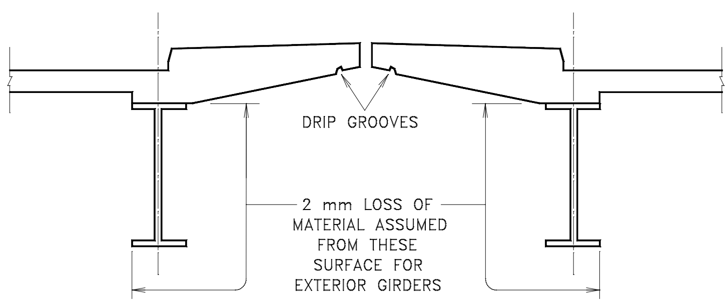
(m) Jacking points and loads must be shown.

(n) Accurate determination of structural steel quantities is no longer required of the designer. An estimate of this quantity shall be provided to the Regional Planning and Design or Regional Structural Section for in-house checking and cost estimation purposes only.

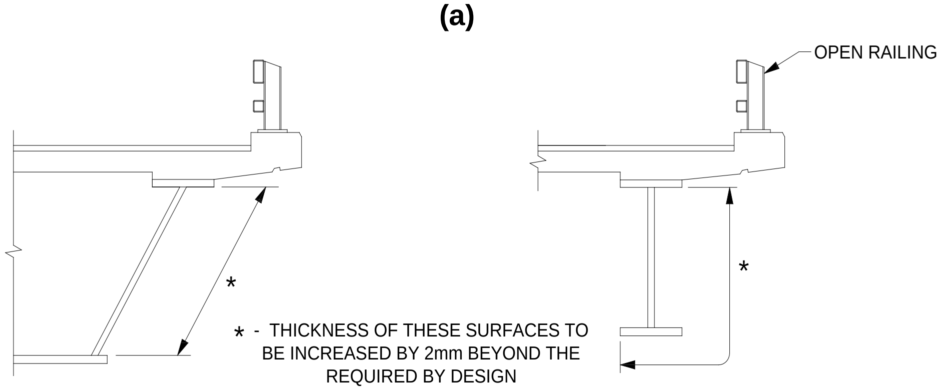
(o) Exterior girders, including girders adjacent to longitudinal median joints, which are not protected from splashing from the roadway above by a solid barrier, shall be checked for structural adequacy assuming a 2 mm loss of steel from all outer surfaces and the soffit (see Fig. 8.1.1(a)).

(p) When open railings are specified for bridges with steel box girders, the exterior webs of the exterior box girders shall have their thickness increased by a minimum of 2 mm beyond what is required by design (see Fig.8.1.1(b)).

When open railings are specified for bridges with steel I-girders, the webs and bottom flanges of the exterior girders shall have their thickness increased by a minimum of 2 mm beyond what is required by design (see Fig.8.1.1(c)).



(a)



(b) (c)

FIGURE 8.1.1 STEEL GIRDERS BELOW LONGITUDINAL JOINT AND OPEN RAILINGS

8.1.2 PROTECTION OF STEEL

An approved shop applied coating is required to protect structural steel at abutments and deck expansion joints from salt laden water run-off. The coatings should be applied as follows: except for integral and semi-integral abutment bridges, all structural steel surfaces including diaphragms and bracing, but excluding surfaces in contact with concrete and the contact surfaces of bolted joints shall be coated for a distance of 3000 mm from the ends of the girders.

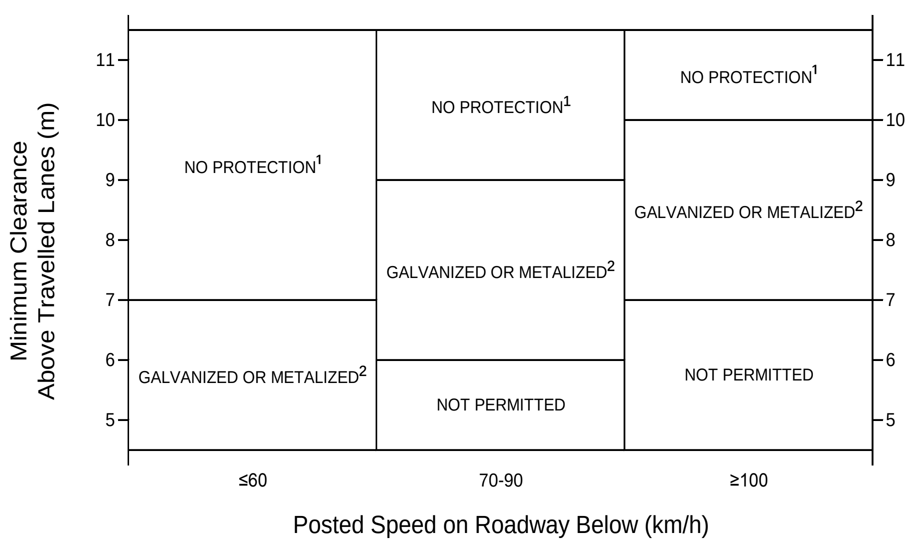
For integral abutment bridges all structural steel surfaces shall be coated for a distance of 700 mm as follows: from the face of the abutment 100 mm towards the ends of girders and 600 mm towards the centre of girders. The colour of the finish coat shall be indicated on the drawings (see 8.8.2).

For semi-integral bridges all structural steel surfaces, except diaphragms, shall be coated as follows: from the ends of the girders to 600 mm beyond the front face of the abutment. The colour of the finish coat shall be indicated on the drawings (see 8.8.2).

Lapped surfaces of sign and light posts are susceptible to crevice corrosion. Contact surfaces at lap joints shall be coated.

8.1.3 USE OF STEEL I-GIRDERS OVER ROADWAYS

Steel I-girders with CSA G40.20/G40.21 steel shall only be used for the ranges of posted speeds and vertical clearances shown in the chart below, along with the specified protection.



Notes:

1. Use uncoated weathering steel with no protection other than that require by the Structural Manual at girders ends and splices.

2. For galvanized or metalized I-girders, Atmospheric Corrosion Resistant (ACR) steel shall be used.

The protection is required to at least the following limits (although a greater extent may be specified for convenience);

a) For exterior girders, for the entire length of the bridge with protection of the exterior top flange, exterior web, entire bottom flange, and 500 mm up the inside face of web.

b) For interior girders, for a length 10m beyond the edge of any future travelled lane with protection of the bottom flange and 500 mm up each face of the web.

Deviations from the above policy require approval from the Bridge Office.

8.2.1 STANDARDISED NOMENCLATURE FOR STRUCTURAL STEEL SHAPES

The designations for various structural sections are standardised as listed below.

SHAPE DESIGNATION	STRUCTURAL SECTION	EXAMPLE
C	Standard Channels	C230x30
HP	H-Pile Sections	HP310x79
HSS	Hollow Structural Sections	HSS101.6x50.8x3.18
L	Angles (Give nominal leg x leg x thickness)	L200x100x13
M	Miscellaneous Shapes	M250x34.1
MC	Miscellaneous Channels	MC250x37.7
MT	Structural Tees. Cut from M Shapes	MT100x24.3
S	American Standard Beams	S460x104
ST	Structural Tees. Cut from S. Shapes	ST 150x37.3
T	Tees	T100x16.7
W	Wide Flange. Give nominal depth x mass per unit length	W410x67
WT	Structural Tees. Cut from W shapes	WT305x108.5
WWF	Welded Wide Flange	WWF700x141

WWT	Structural Tees. Cut from WWF Shapes	WWT250x325.5
Z	Zeds	Z130x17.3

Standard designation for steel plate, e.g. 13 x 510 x 3050, thickness x width x length. Give all dimensions in mm.

8.3.1 STRUCTURAL STEEL BOX GIRDERS - TEMPORARY BRACING

For concrete deck slabs on steel girder bridges to be designed using the empirical method, the CHBDC requires that cross frames or diaphragms, at a maximum spacing of 8.0 m c/c, be provided throughout the cross section of the bridge, inside and between box girders.

When such diaphragms or cross frames are not provided, temporary bracing to prevent displacement or twisting of the girders is required, particularly when the deck is being cast. Tack welding the reinforcing steel to the studs may not in itself be sufficient. The stability of the girders must be ensured as an integral part of the falsework design.

8.3.2 STRUCTURAL STEEL BOX GIRDERS - BOTTOM FLANGES

The weld joining the bottom flange and the web should be detailed so as to minimise any projection of the flange on which salt could collect. Pier and abutment diaphragms shall be coped to clear continuous welding of the web-to-flange joint. At abutments, the copes shall be sealed with weld (see Figure 8.3.2).

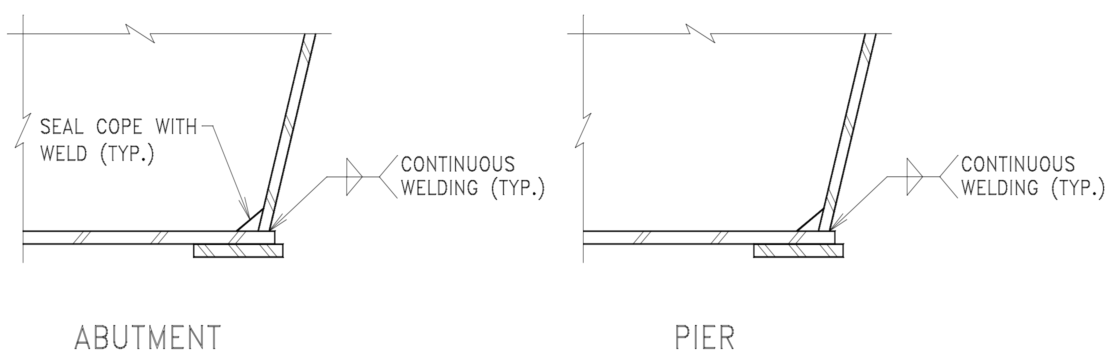


FIGURE 8.3.2 BOTTOM FLANGE WELDING DETAILS

8.3.3 STRUCTURAL STEEL GIRDERS PROFILE

(a) CAMBER

Camber is defined as the built-in deviation of a bridge member from straight, when viewed in elevation. It is intended to compensate for deflections due to all dead loads and usually includes the roadway profile.

Relaxed camber is the camber which compensates for deflection due to all dead loads, including girder + slab + superimposed dead loads, plus the roadway profile. This is necessary since in the process of fabrication, the self-weight of girders is not acting due to the method of girder support. The contract drawings must show the relaxed camber diagram. Girders are cambered to the values shown in the relaxed camber diagram. The camber cutting diagram, used by the fabricator to cut the web plates to shape for girder segments, is calculated by them based on the relaxed camber diagram, and shown only on the shop drawings. Unless the span length(s) is very short, relaxed camber diagram ordinates are given at the 10th point of the span. According to section 10.7.4 of CHBDC, for spans less than 25 m the girders need not be cambered. Variations in concrete haunch thickness can be used, in lieu of providing a camber, to achieve the required screed elevations. Where haunching in lieu of camber is used, variable shear stud lengths might be required.

Steel Plate Girders

Plate girders are fabricated with the web in a horizontal position. For plate girders, the relaxed camber diagram shown on the contract drawings is used to check that the required camber in the shop has been achieved within the allowable tolerances. Deflections for girder segments resulting from self-weight of girders are not required to be shown on the contract drawings.

Steel Box Girders

Box girders are generally fabricated with the webs in an upright position. Both webs are supported at close intervals during fabrication. For box girders, in addition to giving the relaxed camber diagram, it is necessary to show on the contract drawings the girder self-weight deflections for girder segments when simply-supported at the field splice locations. This allows verification in the plant that the girder segments have been fabricated to the required camber (by subtracting ordinates for deflections for girder segments from the relaxed camber diagram ordinates).

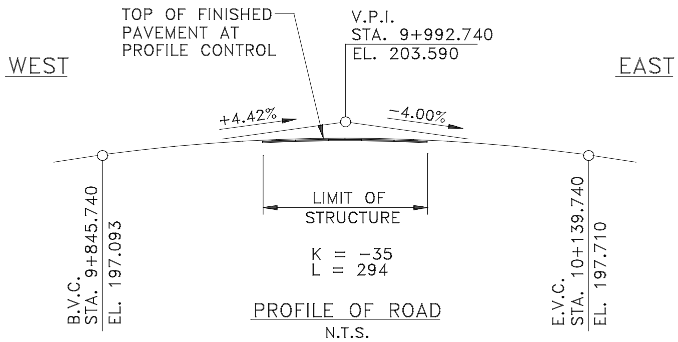
(b) ELEVATIONS

Structural Steel contract drawings shall show girder erection elevations at the top of girders with only the weight of the completely erected structural steel acting. These elevations are given at splice points, mid-span points, piers and abutments. The elevations should always be given to the top surface of the girders, which will be to top of flange or top of splice plate. This must be clearly indicated on the drawings.

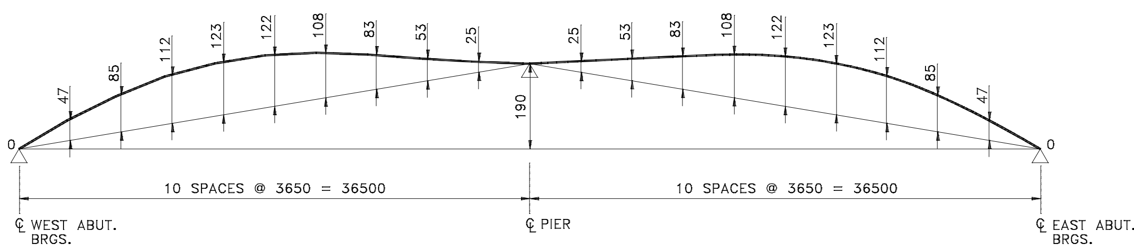
Top of girder elevations are required in order to verify that the girders have been erected within acceptable tolerances to the elevations given on the contract drawings. Prior to pouring the deck, the height of the concrete deck haunches are set in order that the screed elevations shown on the contract drawings can be achieved. The as-constructed girder elevations, at the time the erection of all the girders is completed and accepted by the contractor, are permanently recorded.

(c) EXAMPLE : 2-SPAN STEEL BOX GIRDER

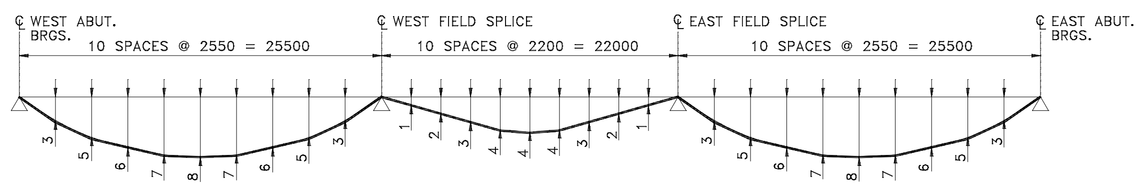
These sketches illustrate the various diagrams required for steel box girders, to be shown on the structural steel contract drawings



PROFILE OF ROAD
N.T.S.
(From General Arrangement drawing)



RELAXED CAMBER DIAGRAM
N.T.S.



DEFLECTIONS FOR GIRDER SEGMENTS
N.T.S.

GIRDER ERECTION ELEVATIONS

GIRDER	℄ W. ABUT. BRGS.	℄ WEST SPAN	℄ W. FIELD SPLICE	℄ PIER	℄ E. FIELD SPLICE	℄ EAST SPAN	℄ E. ABUT. BRGS.
1							
2							
3							
4							

NOTE:
ALL ELEVATIONS ARE TO TOP OF GIRDER AT TOP FLANGE OR TO TOP OF TOP SPLICE PLATE AT FIELD SPLICES, ALONG ℄ OF GIRDER.

Note: If the top flanges at any point are at different elevations due to geometry (horizontal curve of structure or skew of bridge) or different web heights (large deck crossfall), two girder erection elevations will have to be given, one at the top of each flange.

8.3.4 IDENTIFICATION OF TENSION ZONES

To ensure that tension zones in structural steel girders are properly identified so that they can receive the required level of testing, the designer shall identify the tension zones for weld testing for the top and bottom flanges on the girder elevation view of the structural steel drawing. See Figure 8.3.4 for example.

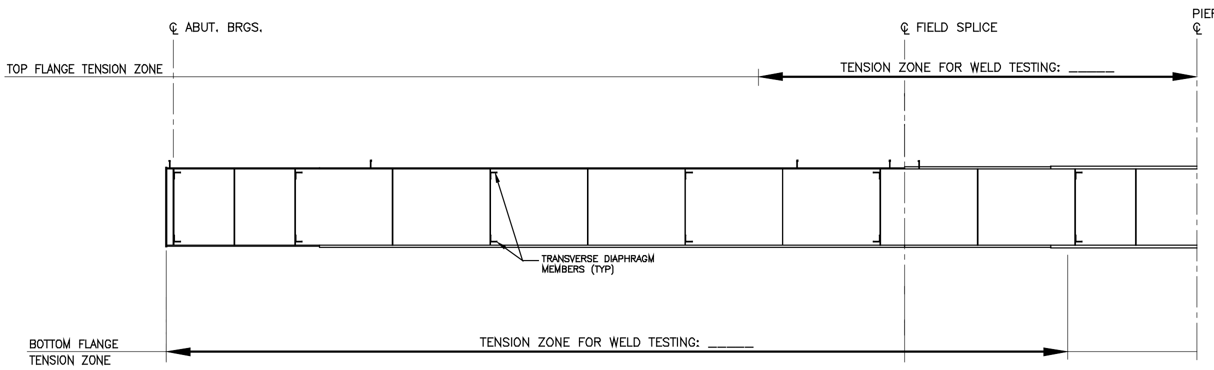


FIGURE 8.3.4 DRAWING SHOWING TENSION ZONES FOR WELD TESTING

8.3.5 BOX GIRDER DRAINAGE AND VENTILATION

Drains are required through the bottom flanges of box girders wherever water can collect. These should be detailed to prevent water from running along the soffit and to keep out birds.

Adequate ventilation of the interior of box girders must be ensured to allow a draft.

8.3.6 BOX GIRDER VOIDS AND ACCESS LOCATIONS

CHBDC clause 1.8.3.1.5 requires access openings for the inspection and maintenance of steel box sections having inside vertical dimensions of 1.20 m or greater.

Box girders with access openings shall have a minimum inside clear height of 1200 mm. The minimum clearance for walking through intermediate cross bracing and diaphragms inside box girders shall be preferably 600 mm and not less than 500 mm.

The number of access openings and their locations shall be as follows:

a) For simple span steel box girders with walk-through cross bracing: Two openings per box girder, one located near each end.

b) For continuous steel box girders with walk-through cross bracing and pier diaphragms: Two openings per box girder, one located near each end. For exceptionally long girders, the need for additional intermediate openings should be determined by the Regional Structural Sections, and stated in the Structural Design Report.

The access openings shall be located to avoid or minimise interference with traffic during inspection and should be easily accessible to inspectors, but not to the general public.

This policy shall apply to all current and future designs, and wherever possible, to stockpiled designs.

8.3.7 CONSTRUCTION STAGE DESIGN REQUIREMENTS

The bridge designer must design the structure considering the construction stage (naked girder) as well as the subsequent stages and their contributions to the final stresses in the girder. Intermediate diaphragms and bracing shall be provided to ensure structural adequacy for all of the above stages and shall remain in place even if some can theoretically be removed after the concrete deck has attained its full 28-day specified strength.

8.4.1 COPING OF STIFFENERS AND GUSSET PLATES

Copes on details such as stiffeners shall be 50 mm horizontally by 4 to 6 times the girder web thickness vertically. Copes on details such as gusset plates shall not be less than 4 times nor more than 6 times the girder web thickness (see Figure 8.4.1). These larger copes are desirable for the following reasons:

(1) They prevent the possibility of intersecting welds;

(2) They reduce the high weld shrinkage strains associated with smaller copes; and

(3) They allow drainage.

At end diaphragms, copes are not permitted. This generally dictates a drain at the diaphragm.

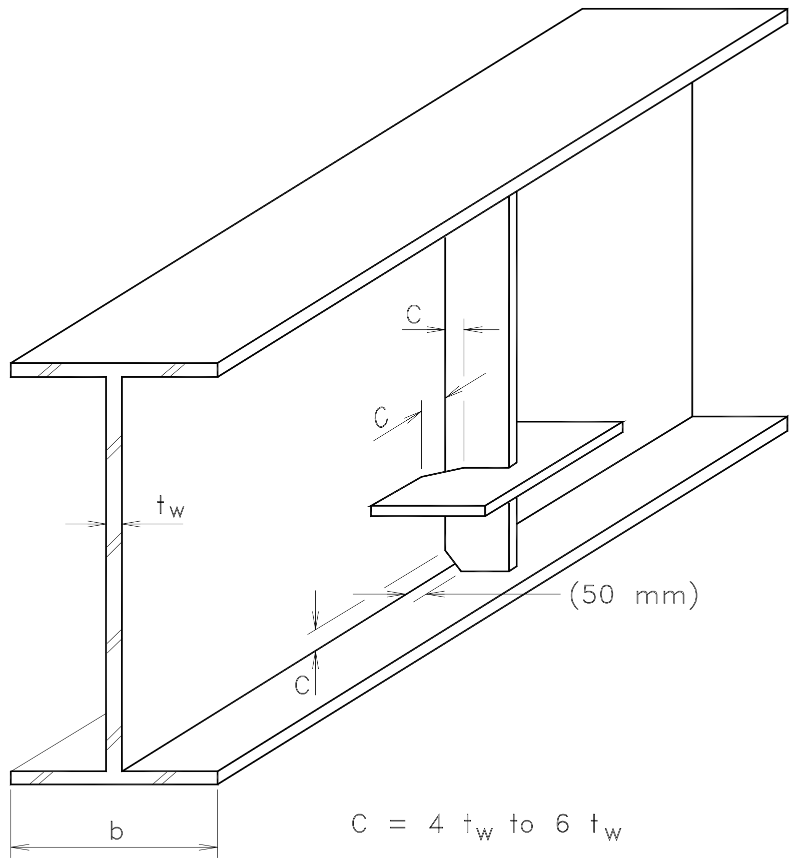


FIGURE 8.4.1 COPING OF STIFFENERS AND LOCATION OF GUSSET PLATES

8.4.2 GUSSET PLATES FOR LATERAL BRACING

All gusset plates for lateral bracing should be fillet welded, and be located a distance as required by the CHBDC and practical situations. The outer corners of the gusset plates should be left square and "Bridge Fatigue Guide, Design and Details" by J. W. Fisher should be consulted when determining the location of bolt holes. See also Figure 8.4.1.

Two factors have been taken into consideration in determining the position of lateral bracing gusset plates.

(1) Access for fabricating and inspecting the gusset plate-to-web connection; and

(2) The improved fatigue performance which results when the gusset plate is moved away from the flange into a lower stress region.

Although this is the preferred detail, under certain circumstances a designer may wish to consider a radiused gusset plate or a bolted connection.

8.4.3 FRAMES FOR INTERMEDIATE BRACING

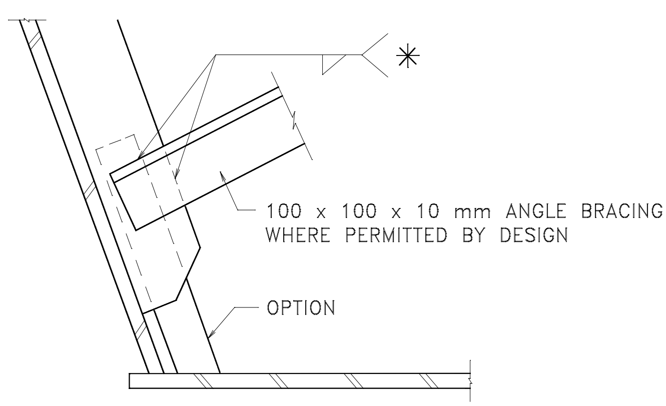
Frames should be used for intermediate bracing in lieu of angle sections shipped loose to the site. The frames for use between girders should be designed for shipping and erection as a single unit. All frames should be designed and detailed for fabrication from one side, eliminating the need for "turning over" during fabrication. A "K" brace angle system is preferred, using rectangular gusset plates. Oversized holes in the gusset plates are permitted.

The preferred "K" brace system for use between girders should consist of angles shop welded to one side of gusset plates which would be field bolted to the girder stiffeners. It results in more economical fabrication and erection procedures when all frames are produced in one jig and when fewer pieces are handled in the field.

8.4.4 BOX GIRDER BRACING

Unless design requirements dictate otherwise, 100 x 100 x 10 mm angles should be used as a standard angle size for box girder bracing. If additional interior bracing is required for handling of the girders, in excess of what the contract drawings call for, the fabricator shall show this on the shop drawings which shall be subject to approval by the Ministry. The designer should ensure that the interior bracing can be welded to the web stiffeners (see Figure 8.4.4); and if design permits in the case of X-bracing, the intersection of the two bracing elements need not be connected.

Because of minimum tonnage orders that can be placed with mills, standardisation of angle bracing will result in economy. The size chosen is believed to be adequate for the normal range of bridge spans built in Ontario. Additional economies can be achieved when connection details are such that fabrication can be performed more easily.



(*) : WHERE POSSIBLE, WELD ALONG TOP AND BOTTOM LANDINGS OF BRACING, OTHERWISE ALONG VERTICAL FACE OF STIFFENER AND TOP OR BOTTOM LANDING OF BRACING.

FIGURE 8.4.4 BOX GIRDER BRACING

8.4.5 INTERMEDIATE DIAPHRAGMS IN SHALLOW GIRDERS

Constant depth intermediate diaphragms, in lieu of frame bracing, are preferred in I-girders bridges up to approximately 1200 mm -in girder depth.

Diaphragms fabricated from channel or beam sections would be less expensive in shallow bridges.

8.4.6 BOX GIRDER DIAPHRAGMS AT PIERS AND ABUTMENTS

Diaphragms at piers should be detailed so that the box girder and diaphragm flanges are not connected (see Figure 8.4.6(a)). Two possible solutions are shown. Also, provisions for jacking within the width of the bottom flange should be provided for by design. Diaphragms at abutments are normally of a shallower depth to allow for deck details. In this case, the box girder flanges should be stabilised against rotation (see Figure 8.4.6(b)). Diaphragms between box girders at piers and abutments should be of constant depth, and bolted to exterior box girder web stiffeners (see Figure 8.4.6(c)). Oversized holes in diaphragms or stiffeners are permitted.

The details as shown in Figure 8.4.6, were developed to meet design and fabrication needs.

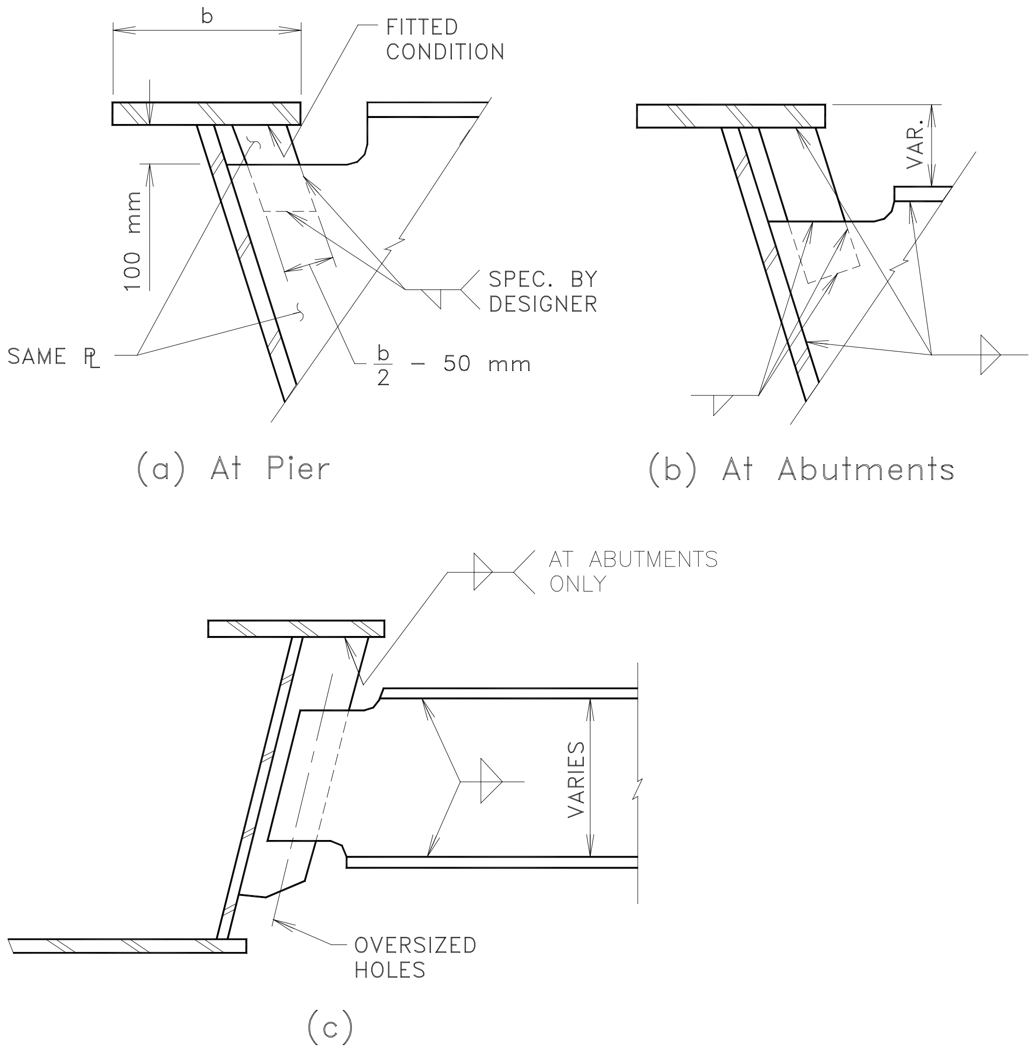


FIGURE 8.4.6 BOX GIRDER DIAPHRAGMS

8.5.1 FLANGE WIDTHS BETWEEN SPLICES

The plate width used for any one flange should be kept constant between field splices.

Flanges for girders are purchased in economical multi-width plates. Where a change in flange thickness occurs, the mill plates are butt welded together. If the flange width is constant for a given shipping length, the plates can be stripped into multiple flanges in one continuous operation.

8.5.2 TRANSITION OF FLANGE THICKNESSES AT BUTT WELDS

Transition of flange thickness at butt welds should be made in accordance with CSA W59 with a slope through the transition zone not greater than 1 in 22.

A slope of 1 in 22 can be produced by burning. Research indicates that this detail achieves the required fatigue categories. Less steep slopes require more expensive fabrication methods with no significant compensating improvement in fatigue classification.

8.5.3 TRANSITIONS OF BOX GIRDER FLANGE AND WEB THICKNESSES

Flange thickness transitions should be made so that a constant depth web plate is maintained. Web thickness transitions should be made to maintain a flush outer box girder face.

Flange thickness transitions, made so that a constant web depth is maintained, result in economy. Web thickness transitions made so that a flush outer face is maintained, facilitate web splice details. In the event that a horizontal web stiffener is required by design, a flush outer face makes fabrication easier. Note that eccentric transitions produce small local bending effects which can be significant where elastic instability is possible, e.g. in tension plates temporarily subject to compression during construction.

8.6.1 GRINDING OF BUTT WELDS

In the following, "Flush" is defined as: the condition in which there is a smooth gradual transition between base and weld metal, involving grinding where necessary to remove all surface lines and to permit radiographic testing (RT) or ultrasonic testing (UT) examination. Weld reinforcement not exceeding 1 mm in height may remain on each surface, unless the weld is part of a faying surface, in which case all reinforcement shall be removed.

"Smooth" is defined as: the condition in which the surface finish of weld reinforcement has a sufficiently smooth gradual transition, involving grinding where necessary to remove all surface lines and to permit RT or UT examination. Weld reinforcement not exceeding the following limits may remain on each surface.

For plate thicknesses < 50 mm, 2 mm

For plate thicknesses > 50 mm, 3 mm

(a) Butt welds in webs of girders designed for tension in category B shall be "flush" for a distance of 1/3 the web depth from the tension flange.

(b) All other butt welds designed for tension in category B shall be "flush".

(c) Butt welds designed for compression only or for stresses in category C shall Be at least “smooth”.

These recommendations are in line with the latest fatigue rules. For welds specified to be ground "flush", weld reinforcement of 1 mm is allowed (except in the case of faying surfaces) reducing the possibility of over-grinding and repair.

In webs of girders, butt welds more than 1/3 the girder depth from the tension flange are in a lower stress range. This results in a less severe fatigue category not requiring the "flush" condition.

Where the contour of the weld is to be "smooth" grinding may be required to permit RT or UT examination of the tension welds. Compression welds may require grinding if the weld reinforcement limits are not met.

8.6.2 BEARING SHOE PLATE WELDS

Bearing shoe plates should preferably be welded only longitudinally to plate girder flanges. If the shoe plates are to be welded in the field, they should be wider than the girder flanges to facilitate welding in the horizontal position.

For box girders, unless design requirements dictate otherwise, double bearings should be used at both piers and abutments. Where the bearing shoe plates are to be welded in the field, they should be positioned so as to allow longitudinal welds in the horizontal position between flange and shoe plate. In addition, short transverse welds, between flange and shoe plate, of approximately 150 mm in length, should be provided (see Figure 8.6.2). Sufficient access should be provided to execute these transverse welds.

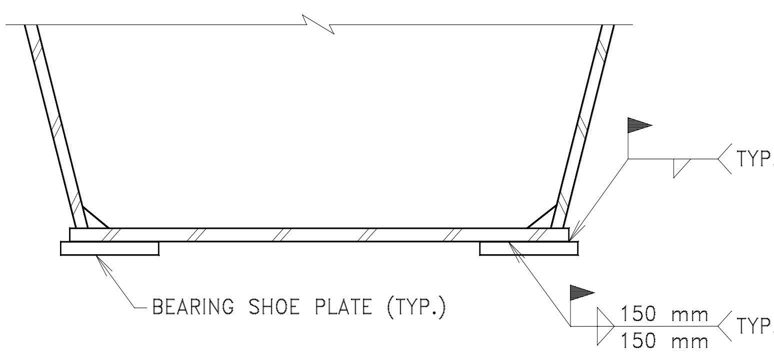


FIGURE 8.6.2 BEARINGS AT PIERS & ABUTMENTS

8.6.3 BOLT GRID

Bolt holes should be set on a 80 mm x 80 mm grid, or multiples of 80 mm, to facilitate the use of multi-spindle drills (see Figure 8.6.3).

The use of a standard grid pattern simplifies fabrication and results in economies.

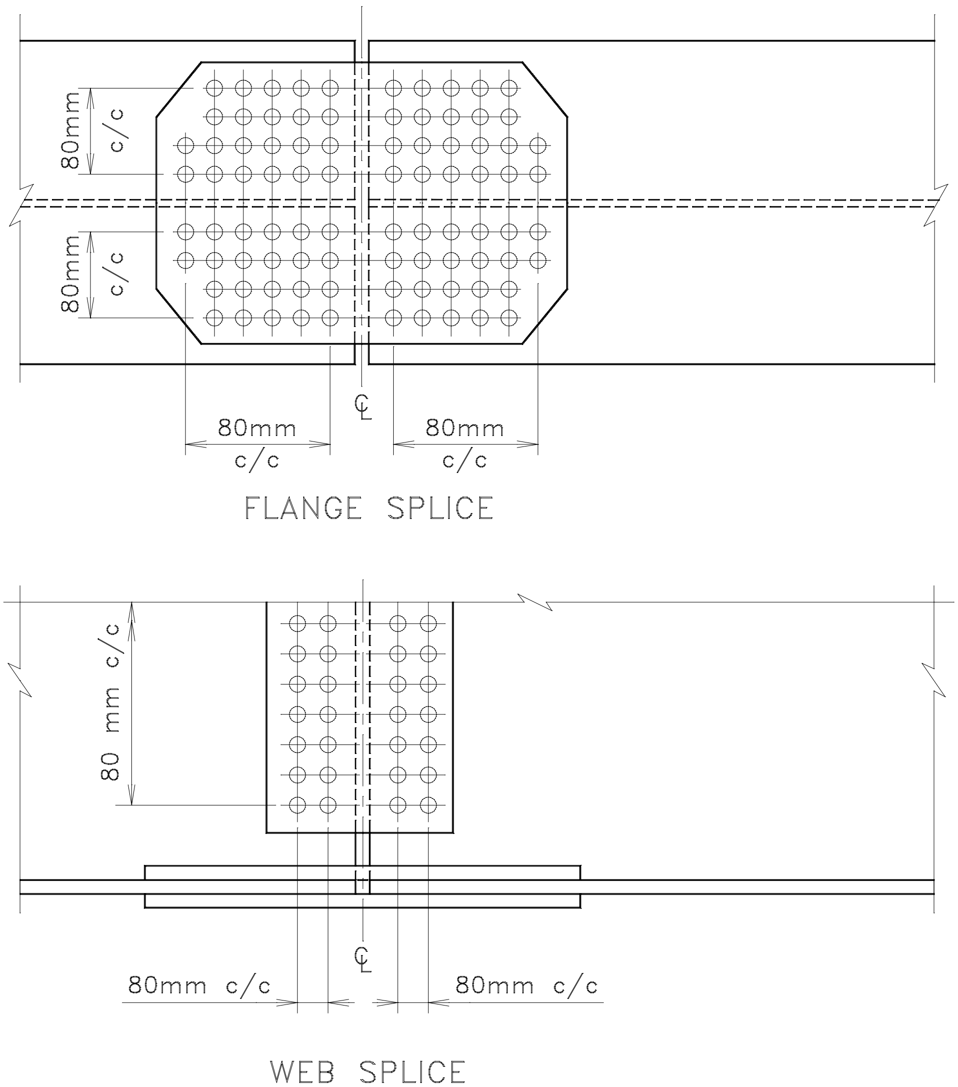


FIGURE 8.6.3 POSSIBLE BOLT LOCATIONS IN A FIELD SPLICE

8.7.1 VERTICAL STIFFENERS

Bearing Stiffeners on plate girder bridges shall be true vertical under full dead load with the requirement noted on the contract documents (see 8.8.2(a)(7)). Intermediate stiffeners may be either true vertical, or perpendicular to fabrication work lines, depending on the fabricator's practice.

The recommendation for bearing stiffeners to be true vertical under full dead load is primarily for aesthetics with the normal pier and abutment designs. Vertical diaphragms would also result at the bearing points, which will facilitate the jacking arrangement for bearing maintenance. Some fabricators choose to work from a horizontal work line on the webs of girders and install intermediate stiffeners perpendicular to these work lines with the girder in a relaxed condition. When the dead load acts, the intermediate stiffeners are not vertical, but the difference is slight with no functional loss.

8.7.2 BEARING STIFFENER TO FLANGE CONNECTION

Bearing stiffeners, irrespective of thickness, shall be fitted to bear and welded to both flanges at abutment locations as well as at interior supports, as shown in Figure 8.7.2. The size of the weld shall be specified on the contract drawings.

Because the load being transferred through the stiffeners may be too large to be transferred through the welds alone, bearing stiffeners are required to be fitted to bear in their contact to the inner surface of the flanges.

OPSS 906 describes the contact tolerance of “fitted” and “fitted to bear”.

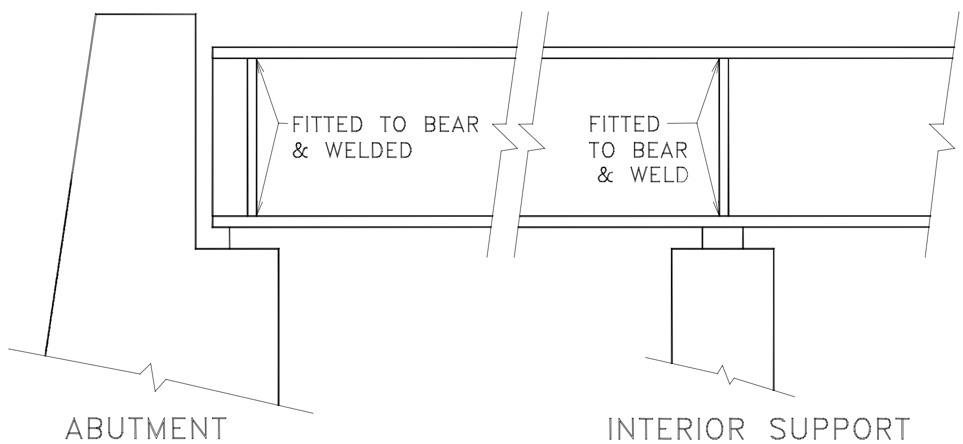


FIGURE 8.7.2 BEARING STIFFENER TO FLANGE CONNECTION

8.7.3 INTERMEDIATE STIFFENER TO FLANGE CONNECTION

Intermediate stiffeners that are used as connection plates on I-girders and on the inside of box girders shall be welded or bolted to both the tension and compression flanges depending on fatigue requirements.

Intermediate stiffeners that are not used as connection plates on I-girders and on the inside of box girders shall be welded to the compression flange and snug fit or welded to the tension flange depending on fatigue requirements.

8.7.4 STIFFENER TO WEB CONNECTION

All stiffeners shall be welded to the webs of the girders by continuous fillet welds which shall not be returned around the end of the stiffener. The size of these welds shall be the larger of the “minimum size” given on the contract drawings and the size which corresponds to a shear force of 0.0001 $hF_y^{1.5}$ as given in the CHBDC.

Continuous welding improves the fatigue performance in a girder by reducing the number of stress raisers. The minimum weld size is specified to reduce residual stresses and web deformations. The weld return about the end of the stiffener is undesirable as it aggravates the fatigue problem in the web between the stiffener and girder flange.

8.7.5 INTERSECTING LONGITUDINAL AND TRANSVERSE STIFFENERS

Where possible, longitudinal stiffeners shall be located on the opposite side of the girder web to intermediate transverse stiffeners. Where longitudinal and transverse stiffeners intersect, the longitudinal stiffener should be cut short of the transverse stiffener. However, in tension regions, where fatigue is a governing design criterion, and where longitudinal and transverse stiffeners intersect, the longitudinal stiffener may be made continuous and the transverse stiffener welded to it at the intersection.

Locating longitudinal and transverse stiffeners on opposite sides of girder webs facilitates fabrication and reduces the number of stress-raisers in the web of the girder.

Intersection of stiffeners is sometimes unavoidable. Cutting the longitudinal stiffener in tension regions results in a category E detail. This detail may be improved by providing a radiused transition, if this category is too severe, or by making the longitudinal stiffener continuous and welding the transverse stiffener to it, resulting in a category C detail.

8.7.6 BOX GIRDER WEB STIFFENERS

Web stiffeners on the inner and outer faces of box girders should be cut short of the bottom flange as shown in Figure 8.7.6 in order to allow use of automatic welding of the web-to-flange joint. This is necessary because the process of fabricating the box girders calls for the web stiffeners to be welded prior to welding the web to the flanges. The stiffener is then extended to the bottom flange by the attachment of a plate as shown in Figure 8.7.6. This plate shall be welded, bolted or fitted to the bottom flange depending on its location (i.e. used or not used as connection plate) and fatigue requirements. The connection of bracing to the outer faces of box girders shall be as shown in Figure 8.7.6.

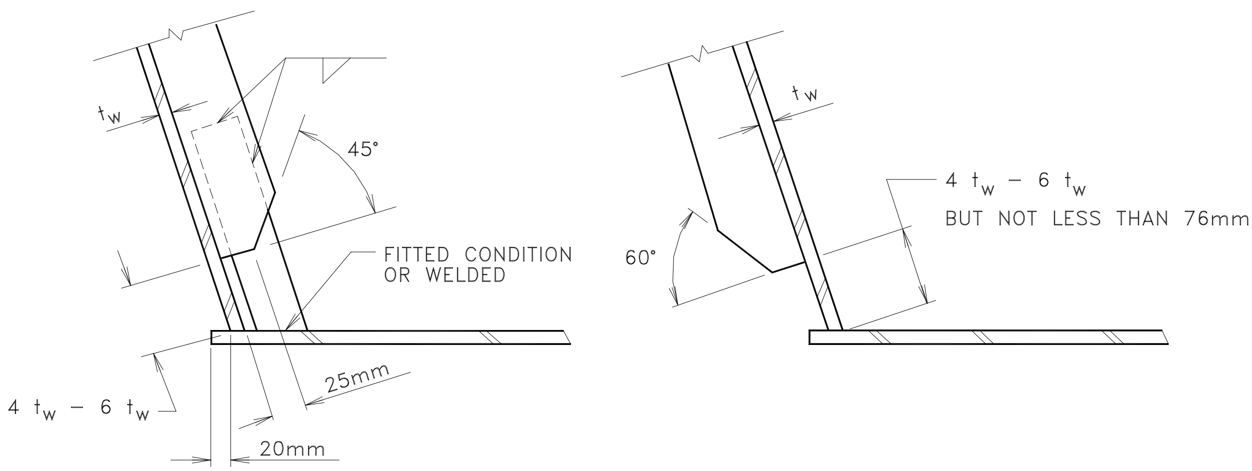


FIGURE 8.7.6 BOX GIRDER WEB STIFFENERS

8.7.7 BOTTOM FLANGE STIFFENER DETAILS

Wide flange "I" or "T" section longitudinal bottom flange stiffeners are preferred in lieu of plate sections. The sections should be spaced a minimum of 305 mm between flanges to allow the use of automatic welding equipment. Channel sections, welded to the top of the wide flange longitudinal stiffeners, and to the inner web stiffeners, are preferred as transverse bottom flange stiffeners (see Figure 8.7.7).

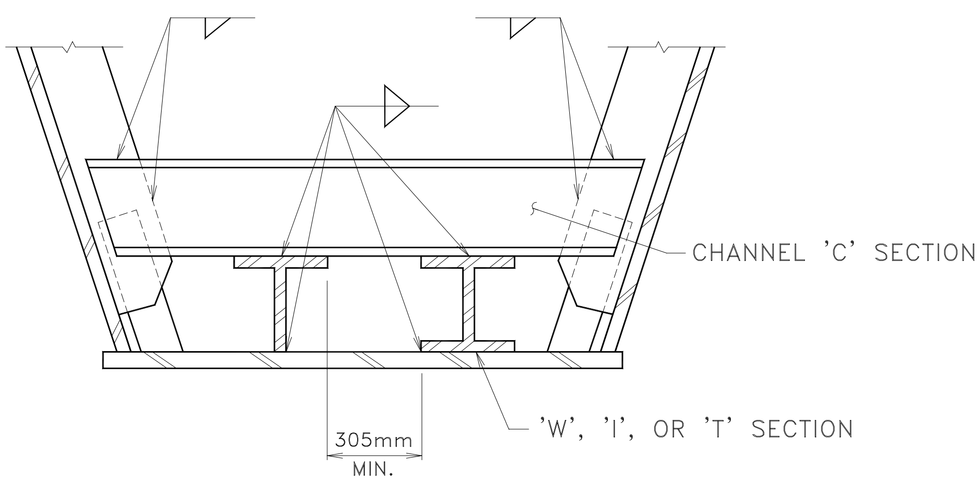


FIGURE 8.7.7 BOTTOM FLANGE STIFFENER DETAILS

8.7.8 TRANSITION RADIUS FOR LONGITUDINAL STIFFENERS AND GUSSET PLATES

The ends of the transition radius for radiused gusset plates and longitudinal stiffeners shall be ground smooth (see Figure 8.7.8). The minimum radius (R) shall be based on the target fatigue category required in accordance with clause 10.17 of the CHBDC.

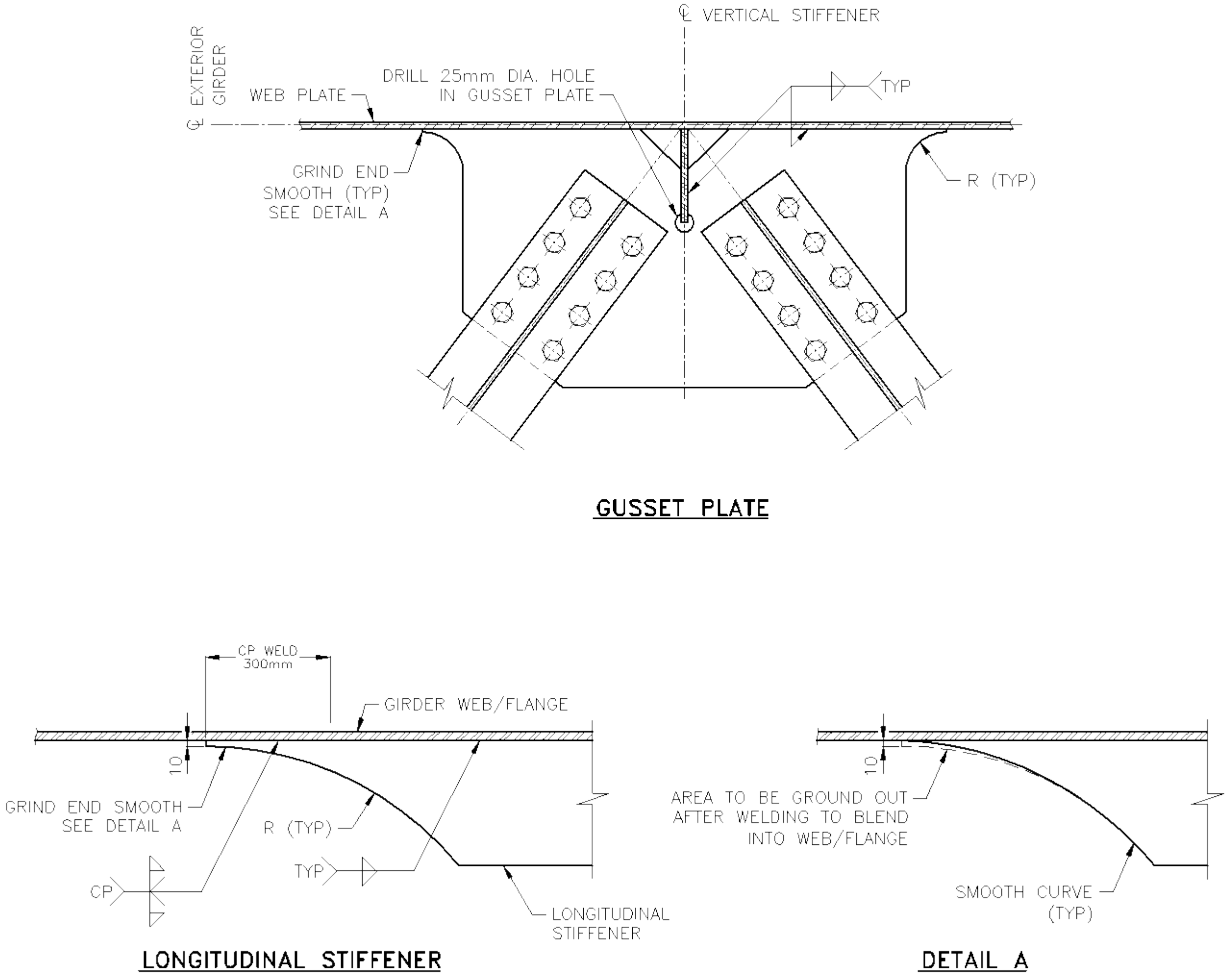


FIGURE 8.7.8 TRANSITION RADIUS FOR GUSSET PLATES AND LONGITUDINAL STIFFENERS

8.8.1 DRIP TAB DETAILS

Drip tabs are used on ACR steel beams and girders. Their function is to reduce or eliminate objectionable staining of the concrete substructure. When required, they shall be attached to all steel beams or girders in the shop since staining may occur prior to slab placement.

Drip tabs should be shown both in plan and in elevation. Typically they should be located such that the ends of the tabs are at a distance of 1.0 m in front of the front face of the abutment wall.

Structures on crest curves shall have tabs in front of both abutments. Structures on a grade shall have tabs in front on the abutment on the low side of the bridge only. Structures with a sag curve, where the low point is away from the abutments, do not need drip tabs.

Drip tabs falling within the coated zone specified in section 8.8.2 note 13 shall also be coated.

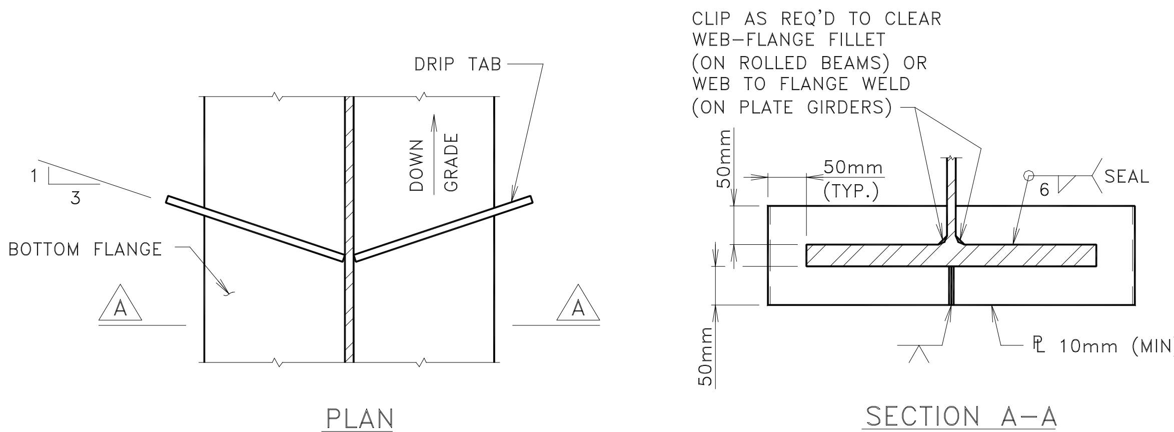


FIGURE 8.8.1 (a) DRIP TAB DETAILS FOR I-GIRDERS

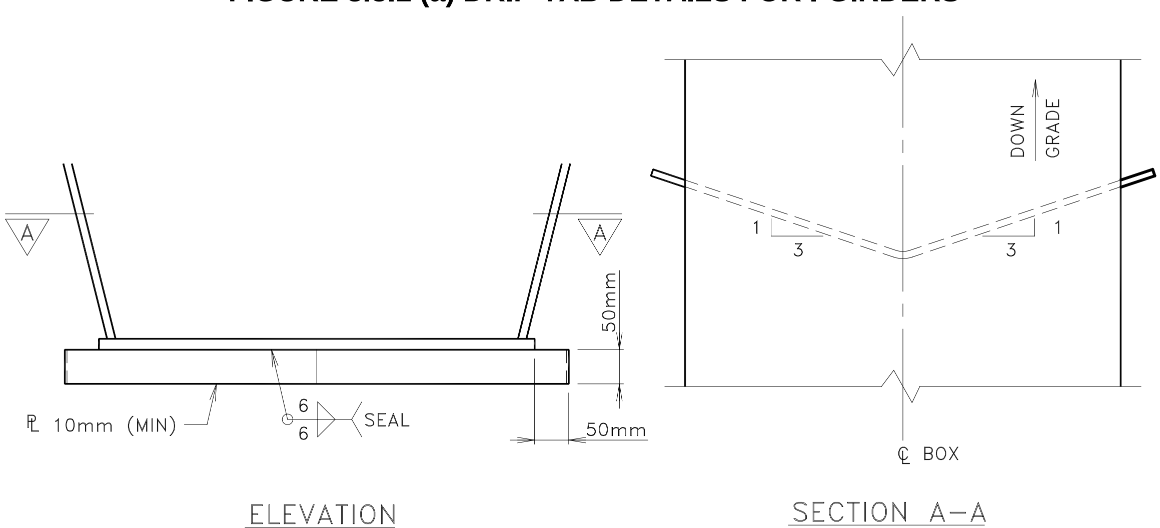


FIGURE 8.8.1 (b) DRIP TAB DETAILS FOR BOX GIRDERS

8.8.2 STRUCTURAL STEEL NOTES

The following are standard notes of the type shown below the title block on the appropriate drawing. The notes must be worded to cover the requirements specific to the particular project and should only be used if applicable. Other notes may be required in special circumstances.

For clarity the wording of the notes is shown in upper case (capital) lettering. Explanations shown in brackets in lower case lettering are not part of the notes.

(a) GENERAL NOTES

1. ALL STRUCTURAL STEEL SHALL CONFORM TO CSA STANDARD G40.20/G40.21 GRADE 350AT. THE CHARPY IMPACT ENERGY REQUIREMENTS SHALL BE 27 JOULES AND THE TEST TEMPERATURE SHALL BE…….°C (Note: Obtain the test temperature requirements from the appropriate table of CSA S6 for the service temperature given for the location). ROLLED SECTIONS SHALL CONFORM TO CSA STANDARD G40.20/G40.21 or ASTM SPECIFICATION A588. (Note: Add Charpy impact test requirements if necessary)

2. BOLTS ON ATMOSPHERIC CORROSION RESISTANT STEEL SHALL BE ASTM A325 TYPE 3, M22. BOLTS ON COATED STEEL SHALL BE GALVANIZED ASTM A325M TYPE 1, M22. BOLT THREADS SHALL BE EXCLUDED FROM THE SHEAR PLANES.
(Note: ASTM A490M Type 3 bolts may be substituted for ASTM A325M Type 3 bolts on ACR steel, but galvanized A490 Type 1 bolts on coated steel are not permitted because of delayed fracture due to hydrogen embrittlement.).

3. STUD SHEAR CONNECTORS SHALL BE 22 mm DIA., AND CONFORM TO ASTM STANDARD A108 AND CSA W59.

4. ALL LENGTHS SHOWN ARE IN THE HORIZONTAL PLANE AND MEASURED AT 20^{o}C.

5. GIRDERS SHALL BE CAMBERED TO VALUES SHOWN IN THE RELAXED CAMBER DIAGRAM.

6. RELAXED CAMBER ORDINATES INCLUDE AN ALLOWANCE FOR GIRDER SELF-WEIGHT, CONCRETE DECK, SUPERIMPOSED DEAD LOADS AND PROFILE OF HIGHWAY.

   (Note: If the bridge is a multi-span steel box-girder structure, the following note should be included.)

   ADJUSTMENTS SHALL BE MADE TO THE RELAXED CAMBER DIAGRAM TO COMPENSATE FOR THE DEFLECTION OF THE INDIVIDUAL GIRDER SEGMENTS.

7. THE ENDS OF GIRDERS AND BEARING STIFFENERS SHALL BE TRULY VERTICAL UNDER FULL DEAD LOAD.

8. ALL BUTT WELDS IN FLANGE AND WEB SHOP SPLICES SHALL BE FINISHED FLUSH OR SMOOTH AS INDICATED, BY GRINDING WHERE NECESSARY IN THE DIRECTION OF APPLIED STRESSES. IF SHOP SPLICES ARE REQUIRED IN LOCATIONS OTHER THAN THOSE WHERE PLATE SIZES HAVE TRANSITIONS, THEIR LOCATION SHALL BE APPROVED BY THE ENGINEER.

(Note: The weld finishes to be indicated on the drawing using the appropriate standard symbol (see 8.6.1)).

9. UNLESS OTHERWISE NOTED THE MINIMUM FILLET WELD SHALL BE AS FOLLOWS:

MATERIAL THICKNESS OF THICKER PART JOINED (mm)	MINIMUM SIZE OF SINGLE PASS FILLET WELD (mm)
TO 12 INCLUSIVE	5
OVER 12 TO 20	6
OVER 20 TO 40	8
OVER 40 TO 60	10
OVER 60 TO 120	12

10. UNLESS OTHERWISE NOTED, LONGITUDINAL WEB STIFENERS SHALL BE CUT 25 mm SHORT OF THE TRANSVERSE WEB STIFFENERS.

11. BOLT HEADS IN FIELD SPLICES FOR BOX GIRDERS SHALL BE LOCATED ON THE EXTERIOR SURFACES.

12. ALL STRUCTURAL STEEL SURFACES, INCLUDING DIAPHRAGMS AND BRACING, BUT EXCLUDING SURFACES IN CONTACT WITH CONCRETE AND THE CONTACT SURFACES OF BOLTED JOINTS SHALL BE COATED FOR A DISTANCE OF 3000 mm FROM THE ENDS OF GIRDERS AT EXPANSION JOINTS. THE COLOUR OF THE TOPCOAT SHALL BE ....

(The colour of the top coat or finishing coat to be inserted by the designer as follows:

10045 brown According to Federal Standard 595C Colours (for ACR steel girder bridges.)

or

16307 grey According to Federal Standard 595B Colours (for all other steel including any ACR steel used in the rehabilitation of carbon steel structures.))

13. If the bridge is integral the following note shall be added:

    ALL STRUCTURAL STEEL SURFACES SHALL BE COATED FOR A DISTANCE OF 700 mm AS FOLLOWS: FROM THE FRONT FACE OF THE ABUTMENT 100 mm TOWARD THE ENDS OF GIRDERS AND 600 mm TOWARDS THE CENTRE OF GIRDERS. THE COLOUR OF THE TOPCOAT SHALL BE …………

    (The colour of the topcoat or finishing coat to be inserted by the designer should be as shown in note 12.)

    If the bridge is semi-integral the following note shall be added:

    ALL STRUCTURAL STEEL SURFACES, EXCEPT DIAPHRAGMS, SHALL BE COATED AS FOLLOWS: FROM THE ENDS OF THE GIRDERS TO 600 mm BEYOND THE FRONT FACE OF THE ABUTMENT. THE COLOUR OF THE TOPCOAT SHALL BE ……..

    (The colour of the topcoat or finishing coat to be inserted by the designer should be as shown in note 12.)

14. CONTRACTOR SHALL ENSURE THE STABILITY OF ALL COMPONENTS DURING HANDLING, TRANSPORTATION AND ERECTION AND UNTIL THE STRUCTURAL STEEL IS IN ITS FINAL LOCATION WITH ALL PERMANENT BRACING, CONNECTIONS AND SUPPORTS IN PLACE AND THE CONCRETE IN THE DECK HAS REACHED 75% OF ITS SPECIFIED STRENGTH.

15. If the bridge is a multi-span steel box-girder structure, the following note 15 should be included:

    ADJUSTMENTS SHALL BE MADE TO THE RELAXED CAMBER DIAGRAM TO COMPENSATE FOR THE DEFLECTION OF THE INDIVIDUAL GIRDER SEGMENTS.

16. Unless the entire exterior I-girder is coated at field splice locations. The designer shall add the following note to the structural steel drawings:

    ALL STRUCTURAL STEEL SURFACES OF EXTERIOR I-GIRDERS, INCLUDING SPLICE PLATES, BUT EXCLUDING SURFACES IN CONTACT WITH CONCRETE AND THE CONTACT SURFACES OF BOLTS JOINTS, SHALL BE COATED FOR A DISTANCE OF 2000 mm ON EITHER SIDE OF THE CENTRELINE OF A FIELD SPLICE.

    (Note: The coating work for the field splice shall be covered in the tender item “Coating New Structural Steel” and a NSSP shall be included in the contract to modify OPSS 911 for the following:

- The faying surface of a splice plate shall only be blast-cleaned to SP6 but not coated.
- The primed faying surfaces of the girder and the primed exposed surfaces of splice plates shall be solvent cleaned and power-tool cleaned to SP3 immediately prior to connection. Coatings damaged by the bolting operations shall be repaired accordingly to OPSS 911.)

(b) NOTES (on DECK DETAILS drawing, structural steel girder superstructure)

1. SCREED ELEVATIONS ARE TO TOP OF CONCRETE.

2. SCREED ELEVATIONS SHOWN IN TABLE INCLUDE AN ALLOWANCE FOR ROADWAY PROFILE, WEIGHT OF DECK SLAB AND SUPERIMPOSED DEAD LOAD.

3. CONCRETE IN DECK SLABS AND DIAPHRAGMS SHALL BE RETARDED USING A TYPE B OR D ADMIXTURE TO ENSURE THAT THE CONCRETE REMAINS PLASTIC FOR THE DURATION OF EACH PLACEMENT.

4. CONCRETE SHALL REMAIN PLASTIC IN POURING OF SEGMENTS WITH THE SAME SEQUENCE NUMBER.

5. MINIMUM CONCRETE STRENGTH OF PREVIOUS DECK PLACEMENT SHALL BE 20 MPa BEFORE PROCEEDING WITH THE PLACEMENT.

6. CONCRETE IN BARRIER WALLS (AND SIDEWALK(S)) SHALL NOT BE PLACED UNTIL ALL CONCRETE IN DECK SLAB HAS REACHED A STRENGTH OF 20 MPa.

7. FALSEWORK FOR THE CANTILEVER PORTIONS OF THE DECK SLAB (FOR A LENGTH OF 2.0 m) SHALL NOT BE REMOVED UNTIL THE CONCRETE AROUND THE INSTALLED EXPANSION JOINT HAS REACHED A STRENGTH OF 20 MPa (TYP. AT ALL FOUR CORNERS OF THE BRIDGE).

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9 DECK AND CURBS

9.1.1 BRIDGE DECK WATERPROOFING

Bridge decks detailed with an asphalt wearing surface must also be shown as being waterproofed. The drawings should state only "Asphalt and Waterproofing System, 90 mm total." (see 2.5.7).

9.1.2 FUTURE WEARING SURFACE

All structures detailed with a concrete wearing surface shall be designed for 90 mm future asphalt wearing surface. To allow for wear, the cover to the reinforcing steel from the top surface shall be increased by 10 mm.

The heights of curbs and barrier walls should not be increased to accommodate the future wearing surface.

9.2.1 STRUCTURE DECK DRAINAGE

Structures having not more than two lanes draining to one side, built with normal crossfall to a more or less symmetrical vertical curve and not more than 120 m long, normally do not require deck drainage inlets.

Requirements for deck drainage inlets must be established by Regional Planning and Design staff as part of the overall drainage design of the crossing. The size and number of drains shall ensure that during a 10-year design storm, the maximum lateral spread distance be such that a minimum of 2.5 m of the lane adjacent to the barrier or curb remains clear of any flooding. Bridge deck drains shall be provided only where this criterion is exceeded.

For bridges on grades or sag curves, the roadway surface runoff shall be intercepted by catch basins or other means located on the approaches to prevent flow into the expansion joints or onto the bridge deck.

When bridge deck drainage inlets are required, they shall be used with an airdrop discharge. Water may not be discharged onto railway property, pavements, sidewalks, unprotected embankment slopes or waterways if environmental concerns prevail. When water is discharged onto other surfaces, where stability or appearance is a consideration, provision shall be made to prevent scour. The position and length of the discharge pipes shall be such that water falling at an angle of 45^o to the vertical does not touch any part of the structure. Discharge pipes should project 400 mm below the bottom flange of adjacent girders to prevent splash. Consideration, however, must also be given to minimum vertical clearance requirements and aesthetics. Pipes need not be attached to adjacent girders if overall length is less than 2.5 m.

200 mm diameter deck drainage inlets do not collect a significant quantity of water and should be used only to prevent local ponding. This is sometimes necessary when flat grades are unavoidable or structures are subject to substantial permanent deflections that cannot be accurately predicted.

Catch basins are normally necessary just beyond the structure limits to intercept runoff from bridge decks. A continuous length of curb or gutter is provided to connect the bridge curb or barrier to the catch basin to prevent wash-outs around the ends of wing walls. Detailing of the wing wall or approach slab should be such as to permit straight vertical junctions with approach curbs. The final grading drawings should be reviewed in conjunction with the structure drawings to ensure that this or an equally acceptable arrangement has been adopted. This should be done by the Regional Structural Section.

9.2.2 DRIP GROOVES

Continuous drip grooves are required along the soffit on both sides of all concrete decks. They should be provided on each side of the joint between abutting twin bridges, even if the joint is sealed.

The dimensions are shown in Figure 9.2.2.

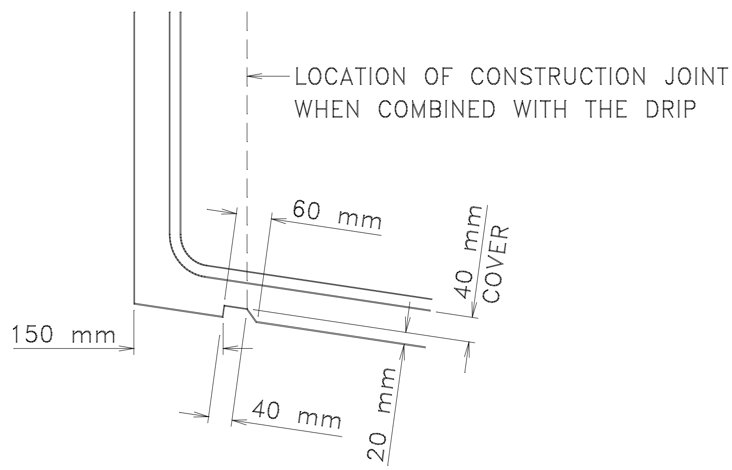


FIGURE 9.2.2 DRIP GROOVE

For practical and aesthetic reasons it may be desirable to combine the drip with construction joints that result from transverse prestress anchorage recesses, or decks with curbs or sidewalks. For this case the drip should not be located greater than 250 mm from the fascia (see OPSD 3390.100).

9.3.1 CONCRETE IN DECK SLABS

In order to ensure adequate durability, the concrete class specified for decks shall be a minimum of 30 MPa.

9.3.2 MINIMUM THICKNESS OF DECK SLABS

In order to permit placing four layers of reinforcing steel with the required cover and associated tolerances, the minimum thickness of deck slabs shall be 225 mm. Such slabs should be detailed so that the bars in the two layers of distribution (longitudinal) reinforcement are not vertically in line with one another. If possible, size 15M bars shall be used except for continuity steel over piers or cantilever steel, for which size 20M or 25M bars may be used.

9.3.3 SEQUENCE OF DECK PLACEMENTS FOR BEAM AND SLAB BRIDGES

No deck placing sequence should be specified, unless there are specific reasons, such as continuous multispan beams with short end spans that could lift off the abutment bearings when concrete is placed in the adjacent span.

When necessary, the deck placing sequence should be shown on the drawings. Each deck placement should be as large as practical, taking into account structure considerations and the availability of concrete. The following notes concerning strength of the previous placement before allowing the next placement should be given on the deck drawing:

CONCRETE STRENGTH OF PREVIOUS DECK PLACEMENT SHALL BE AT LEAST 20 MPa BEFORE PROCEEDING WITH THE NEXT PLACEMENT.

CONCRETE IN DECK SLABS AND DIAPHRAGMS SHALL BE RETARDED USING TYPE “B” OR “D” ADMIXTURE TO ENSURE THAT THE CONCRETE REMAINS PLASTIC FOR THE DURATION OF EACH PLACEMENT.

The deck placing sequence should be shown in numerical order with no duplication of the numerals.

NOTE: Simultaneous concrete placements should not be specified unless absolutely necessary, in which case the intent should be clarified on the deck slab drawing.

9.3.4 REINFORCING STEEL BELOW BARRIER WALLS

Thin slab cantilever decks tend to develop transverse cracks at barrier wall construction joint locations.

In order to control the cracks, the top and bottom longitudinal reinforcement in cantilever slabs under barrier walls, extending 500 mm from the face of the barrier wall or to the outside girder flange, whichever is less, shall not be less than 15M bars at 200 mm centres.

Thin slab cantilever decks with sidewalk do not require this additional crack-control reinforcement.

9.4.1 SCREED ELEVATIONS ON BRIDGE DECKS, CHECK ELEVATIONS ON GIRDERS AND HAUNCHES

a. <u>Pre-cast Prestressed Concrete Girders and Steel Girders</u>

Screed elevations shall be given at the centreline of all exterior girders, the break points in the deck, and on the deck at the faces of curbs and barrier walls. Screed elevations shall be given at intervals not exceeding 3 m.

It is important to ensure that the girders do not penetrate more than 25 mm into the nominal thickness of the deck slab. This may happen if an insufficient allowance has been made at mid-span for the upward prestress camber of precast girders and also if the deck has a sag vertical curve. As a general rule it is necessary to provide haunches raising the bottom of the deck above the top of precast beams, with heights at the supports as follows:

CPCI 900	40 mm
CPCI 1200	50 mm
CPCI 1400 or larger	75 mm
Spaced box beams	50 mm

Screed elevations should include an allowance for long term dead load deflection.

b. <u>Post-Tensioned Concrete Decks</u>

Screed elevations shall be given at break points in the deck, and on the deck at the face of curbs or barrier walls. The screed elevations shall be given at intervals not exceeding 3 m. No allowance is required normally for dead load deflections provided that prestress and dead load are more or less balanced.

c. <u>Haunches</u>

Concrete haunches of varying thickness may be used to fit the top of girders to a deck slab of constant thickness to achieve the proper screed elevation. The haunches shall generally be same width as top flanges and shall not be reinforced unless it is deemed necessary. The shear stud height in a steel girder or stirrup projection in a concrete girder should extend a minimum of 25mm above the bottom mat of bars.

9.4.2 AS-CONSTRUCTED ELEVATIONS

Steel pins used to record as-constructed elevations of bridges shall be installed when called for in the Structural Design Report. The decision to install steel pins shall be made by the Head of the Structural Section in consultation with the Design Section Head of the Bridge Office. Standard drawing SS116-40 shall be included in the contract when steel pins are used.

Steel pins shall only be required where long term settlement can be expected due to specific site conditions and on superstructures that are sensitive to long-term creep effect, such as bridges of segmental construction, or cast-in-place post-tensioned bridges of staged-construction.

9.5.1 STEEL FORMS

Steel forms are considered to have many disadvantages and are therefore not to be used. They are or may become unsightly. They may cause maintenance problems and at the very least impede inspection. It does not appear that there is any economic advantage to their use.

9.6.1 DECK CONSTRUCTION JOINTS

Construction joints across which force effects are assumed to be transmitted or which must resist leakage, require special treatment. This should be specified in an appropriate and current special provision.

It should be noted that waterstops in deck construction joints are no longer used.

9.6.2 WATERPROOFING OF DECK CANTILEVER OF STEEL BOX-GIRDER BRIDGES

For steel box-girder bridges, the curb/sidewalk face should preferably start beyond the exterior flange of the exterior girder. If this is not practical, a special waterproofing system should be used as described below, to prevent salt-laden deck run-off from invading the joint between the slab and the sidewalk, filtering through the deck and into the unprotected steel box-girder, causing serious internal corrosion. This damaging potential is intensified on wide-deck bridges, and especially in the vicinity of piers, where the concrete decks may have numerous flexural cracks in the negative moment region.

A proprietary product (not on the DSM list) such as "Eliminator" is an appropriate waterproofing system that has been used by Metropolitan Toronto in the recent past on the Q.E.W. bridge over the Humber River. It is an acrylic-based system manufactured by Sterling Lloyd Products Inc. The supplier and applicator for this system is LAFRENTZ, located in Oakville, Ontario. This waterproofing should start at 150 mm in front of the face of the sidewalk, continue along the top of the deck/sidewalk construction joint and be turned downwards along the vertical joint face under the barrier wall. The waterproofing system should extend the full length of the bridge.

Although more expensive than the standard bridge deck waterproofing system (hot applied asphalt membrane with protection board), the acrylic based system has several advantages in comparison, such as easier application (spray, brush or squeegee), faster curing time, and harder finished product.

Whenever this requirement is used additional dowels should be added between the deck/sidewalk interface to ensure continuity, and the integrity of the deck cantilever to resist the traffic barrier loads given in clause 3.8.8.1 of CHBDC.

9.7.1 DECK FASCIA DETAILS

Fascia treatment is categorised by deck type and the presence or absence of a sidewalk, as shown in Figure 9.7.1. Slab-on-girder decks with a sidewalk have a 500 mm high fascia, while those decks without a sidewalk have a 350 mm high fascia. Cast-in-place post-tensioned decks have fasciae from 450 to 600 mm high.

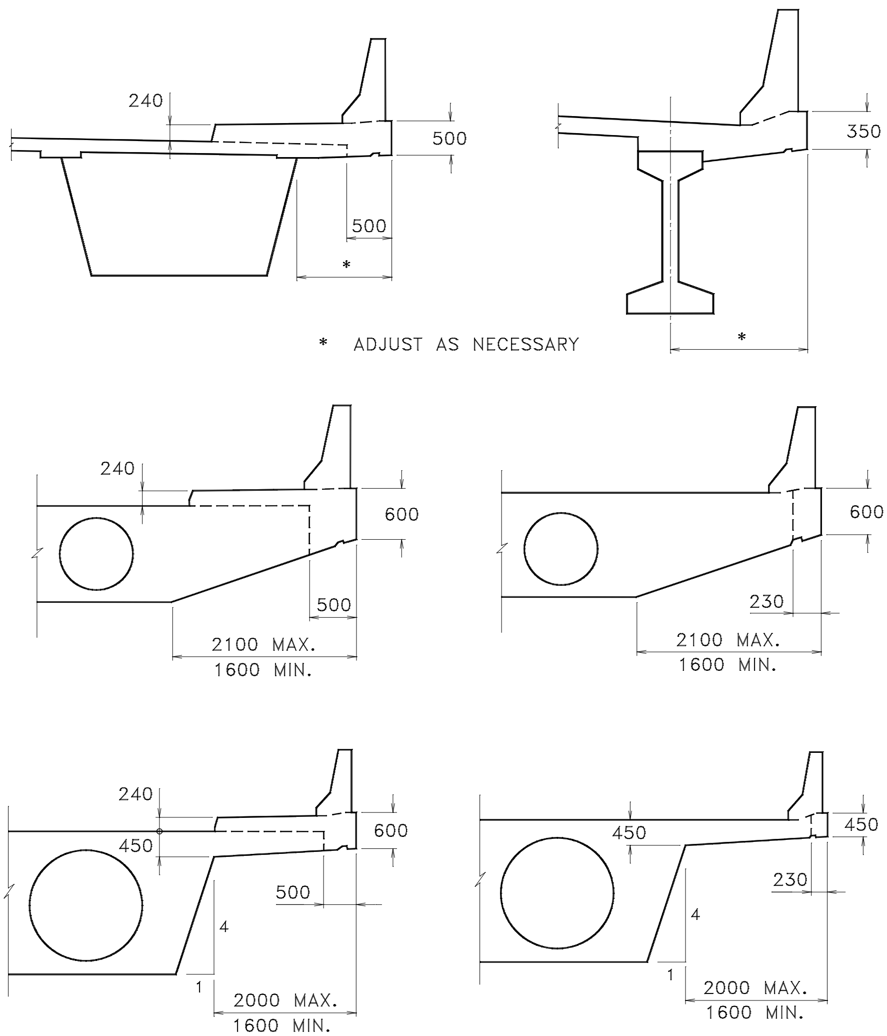
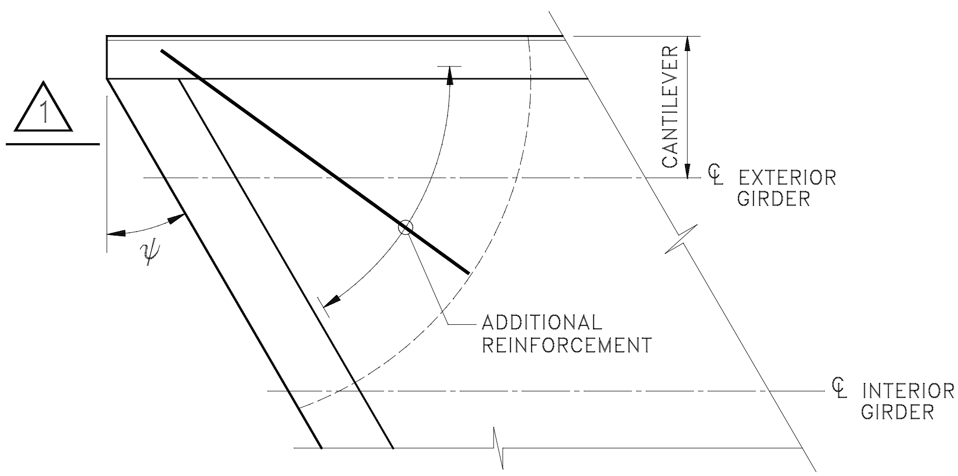


FIGURE 9.7.1 DECK FASCIA DETAILS

9.8.1 ADDITIONAL REINFORCEMENT IN SKEWED DECKS

The following detail shows the additional reinforcement required, unless analysis dictates otherwise, for the cantilevered portion of thin slab bridge decks with skews exceeding 20° but less than 45°, and with the cantilever span not exceeding 1.6 m. Skewed decks with cantilever spans less than 0.6 m do not require this additional reinforcement.

SKEW ψ	CANTILEVER	ADDITIONAL REINFORCEMENT
20° - 35°	0.6m - 1.2m	6 - 20M
20° - 35°	1.2m - 1.6m	6 - 25M
35° - 45°	0.6m - 1.2m	8 - 20M
35° - 45°	1.2m - 1.6m	8 - 25M



PLAN

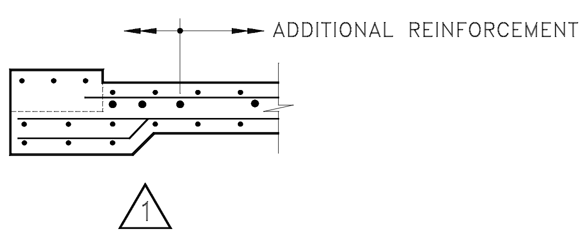


FIGURE 9.8.1 ADDITIONAL RADIAL REINFORCEMENT FOR SKEWED DECKS

The additional reinforcement shall be placed directly under the top layer of deck reinforcement.

No additional radial reinforcement is required at the obtuse-angle corners of the bridge deck.

9.9.1 LONGITUDINAL DECK JOINT BETWEEN STRUCTURES

Where required in the median, the longitudinal deck joint seal between structures shall be detailed on drawings as shown in Figure 9.9.1.

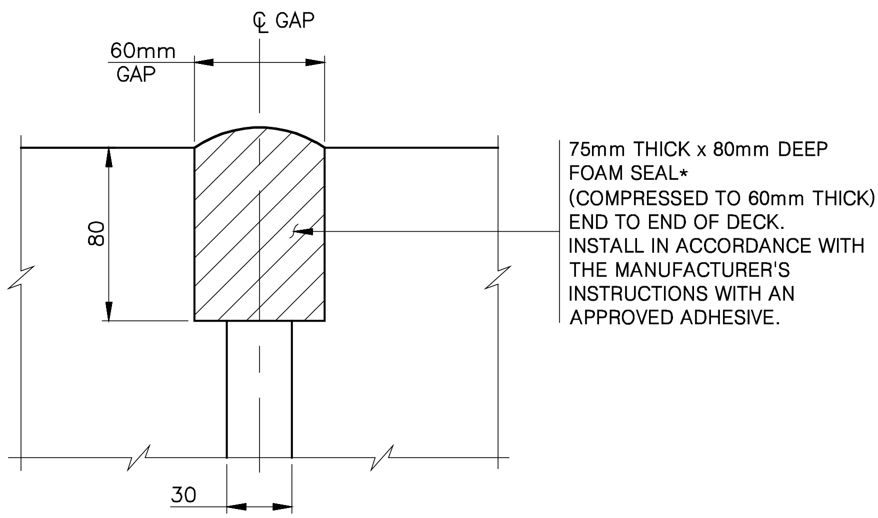


FIGURE 9.9.1 LONGITUDINAL DECK JOINT

* The foam seal shall consist of material that meets the following requirements:

- Has adequate translational capacity.
- Able to be cut to suit the as built configuration and to be fully continuous over the length of the bridge without splices.
- Has a top surface profile to prevent the accumulation of dirt and dust.
- Provides high resistance to the degrading effects of ultra violet light.
- The seal material has a design and adhesive that will provide a durable watertight joint.
- Proven experience in the field.
- Accompanied by a 2-year product performance warranty.

The foam seal “Evazote 380 ESP with H.A.L.S. (Hindered Amine Light Stabilizers)” supplied by E-Poxy industries is considered to be an acceptable product that meets these requirements.

9.10.1 SIDEWALK WIDTHS ON BRIDGES

Sidewalk widths on bridges shall comply with Ontario Regulation 413/12– “Accessibility for Ontarians with Disabilities Act 2005” and the Geometric Design Standards for Ontario Highways. For designs of new bridges with sidewalks or bridge rehabilitations where the sidewalks are rehabilitated, unless otherwise permitted in section 80.31 of the Regulation, the minimum clear sidewalk width shall be 1500 mm. In addition, the minimum clear sidewalk width shall:

- Be maintained over the entire length of the bridge and transition smoothly to the approaches;
- Not be reduced below 1500 mm by appurtenances such as guiderail connections to the bridge;
- Apply to the clear surface of the sidewalk excluding surfaces of other elements such as curbs or tops of walls that are separated from the sidewalk by longitudinal joints.

The above requirements are illustrated in Figure 9.10.1 for greater clarity.

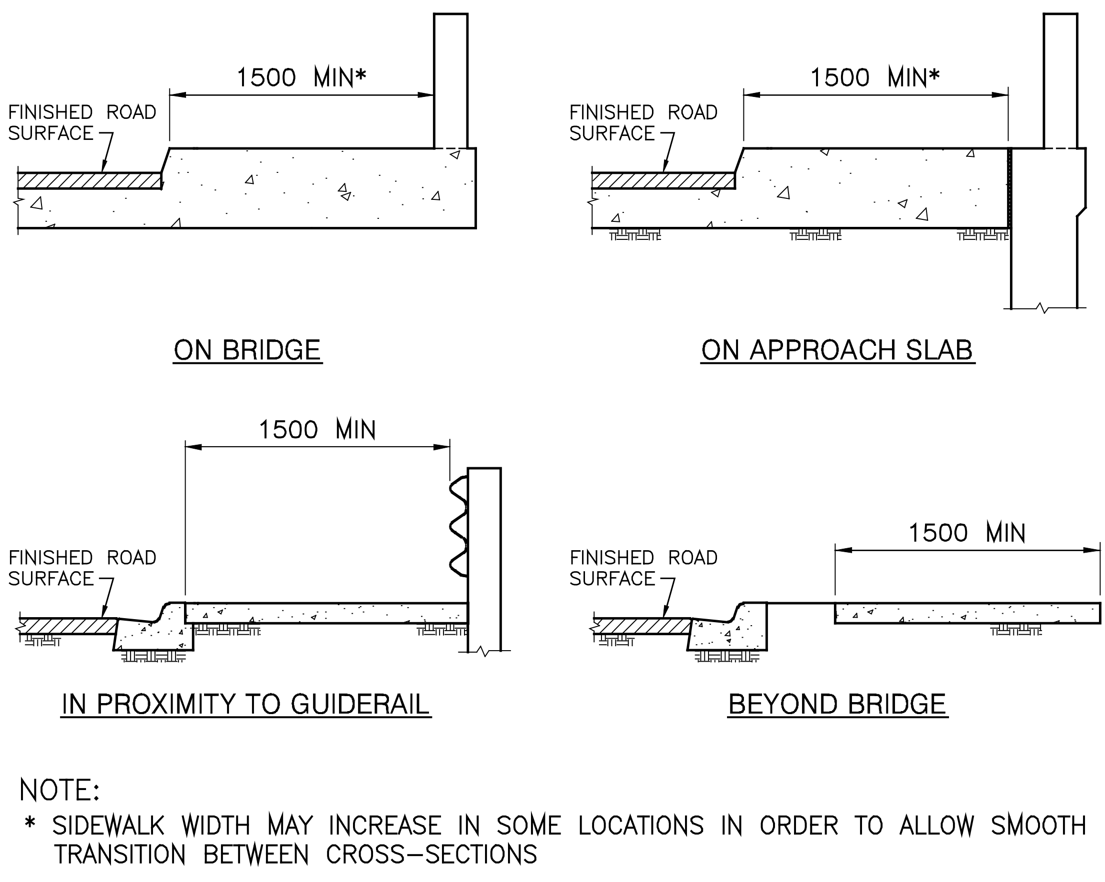


FIGURE 9.10.1 SIDEWALK WIDTH

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10 BARRIERS AND RAILING SYSTEMS

10.1.1 GENERAL

a. Bridge railing shall be selected in accordance with the requirements of section 12 of the CHBDC, that is conforming to TL-2, TL-4 or TL-5, meeting the crash test requirements specified in the NCHRP 350.

Only the railing appropriate for the test level of the bridge site should be used

All bridge railings adopted for use by the Ministry originate from the crash-testing programs carried out in the United States. The current standards used by the Ministry are based on crash tests carried out in accordance with the crash test procedures of the NHCRP 230 "*Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances"* and/or NCHRP 350 "*Recommended Procedures for the Safety Performance Evaluation of Highway Features"* or deemed equivalent. Further information about crash tested barrier systems can be found in AASHTO publications, NHCRP reports, Transportation Research Record, and FHWA memorandums. The reference subsection of the commentary to section 12 of the CHBDC gives a comprehensive listing of pertinent documents, and the following FHWA web site also gives actual details of approved railing systems and memorandums:

http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/bridgerailings/

Some of the accepted bridge rail designs may also be found in the 1995 AASHTO AGC-ARTBA Joint Committee publication "*A Guide to Standardized Highway Barrier Hardware".*

b. Slip forming of concrete barriers on structures is not permitted.

c. When curbs are required, for sidewalks, raised medians etc., they shall be 150 mm high.

10.1.2 DETERMINATION OF BARRIER EXPOSURE INDEX

The barrier exposure index B_e is a number used to determine the required test level of a barrier at a particular location. This number reflects the traffic volumes and bridge characteristics of a particular site that should result in a barrier type that is most suitable for that situation. Example calculations for this determination, based on section 12 of the CHBDC, are given below.

From clause 12.4.3.2.3

$$B_e = \frac{(AADT_1)K_h K_c K_g K_s}{1000}$$

where $AADT_1$ = AADT for the first year after construction

Example 1 – Low traffic volume rural road

Site Data:

Estimated $AADT_1$: 1,500 with 10% trucks
Highway type: two-lane, two-way with design speed of 50 km/h
Highway curvature: tangent
Highway grade: 0%
Superstructure height: roadway passes over a shallow creek with a deck level above normal water level of 4.5 m
Barrier clearance: 1 m shoulder on one side and 1 m shoulder plus 1.5 m sidewalk on other

Calculation:

From the code:

	Factor	Table
Highway type factor K_h	1.2	12.1
Highway curvature factor K_c	1.0	12.2
Highway grade factor K_g	1.0	12.3
Superstructure height factor K_s	0.7	12.4

From clause 12.4.3.2.3 $$B_e = \frac{1500 \times 1.2 \times 1.0 \times 1.0 \times 0.7}{1000} = 1.260$$

From Table 12.5 for worst-case barrier clearance of 1.0 m, 10% trucks and 50 km/h design speed, B_e of 1.260 is < 32. Site requires a **TL-2** barrier.

Example 2 – Single lane ramp

Site data:

Estimated $AADT_1$: 3,100 with 10% trucks
Highway type: one-lane, one-way ramp with design speed of 80 km/h
Highway curvature: 350 m radius
Highway grade: 4%
Superstructure height: roadway passes over high occupancy land use with a deck level 12.2 m above a highway
Barrier clearance: 1 m shoulder on one side and 2.5 m shoulder on other

Calculation:

From the code:

	Factor	Table
Highway type factor K_h	2.00	12.1
Highway curvature factor K_c	3.00 (Outside)	12.2
Highway grade factor K_g	1.50	12.3
Superstructure height factor K_s	1.52	12.4

From Clause 12.4.3.2.3 $$B_e = \frac{3100 \times 2.0 \times 3.0 \times 1.5 \times 1.52}{1000} = 42.408$$

From Table 12.5 for worst-case barrier clearance of 1.0 m, 10% trucks and 80 km/h design speed, B_e of 42.408 is > 5.4 and < 61.4. Site requires a **TL-4** barrier.

<u>Example 3 – High Traffic Volume Urban Freeway</u>

Site Data:

Estimated $AADT_1$:	120,000 with 30% trucks
Highway Type:	two-way divided with design speed of 120 km/h
Highway Curvature:	500 m radius
Highway Grade:	-2.5%
Superstructure Height:	roadway passes over mainline railway tracks with a deck level of 6 m above track bed
Barrier Clearance:	2.5 m shoulders

Calculation:

From the code:

	Factor	Table
Highway type factor K_h	1.0	12.1
Highway curvature factor K_c	1.5	12.2
Highway grade factor K_g	1.125	12.3
Superstructure height factor K_s	0.8	12.4

From Clause 12.4.3.2.3 $$B_e = \frac{120000 \times 1.0 \times 1.5 \times 1.125 \times 0.8}{1000} = 162$$

From Table 12.6 for a barrier clearance of 2.5 m, 30% trucks and 110 km/h design speed, B_e of 162 is > 13.7. Site requires a **TL-5** barrier.

As seen above, the calculation of the barrier exposure index is in itself dependent upon the estimated $AADT_1$, the highway type, K_h, highway curvature, K_c, highway grade, K_g, and superstructure height, K_s, factors as indicated in clause 12.4.3.2.3 of the CHBDC.

10.1.3 TEST LEVELS AND APPROVED BARRIER TYPES

In this section the various test levels and corresponding bridge railing types that have been successfully crash tested and used by the Ministry are described. Note that the railing systems identified in *italics* refer to the name of the railing system that has been crash tested and approved by the FHWA.

1) Test Level 2 (TL-2)

As none of the available crash tested TL-2 systems meet the minimum height and other geometric requirements, none are suitable for sites where pedestrian protection is warranted.

For bridges on low volume roads with an AADT, in both directions, of 400 or less, a lower test level is acceptable. The MTO Bridge Office gives details of its criteria and successful crash test railings in its publication "*Guidelines for the Design of Bridges on Low Volume Roads"*.

The following barrier types are standards used by the Ministry for TL-2:

a. Box beam guide rail – side mount (SS10-40A)

The system in Figure 10.1.3.1(a) is based on the crash tested *California Type 115* bridge railing. Its standard structural "W" and "HSS" shapes provide a relatively inexpensive, easy to fabricate and erect railing suitable for vehicular only warrants on low speed and/or low volume highways.

Its open configuration offers a low profile see through rail for maximum visibility, which is desirable in scenic and rural sites.

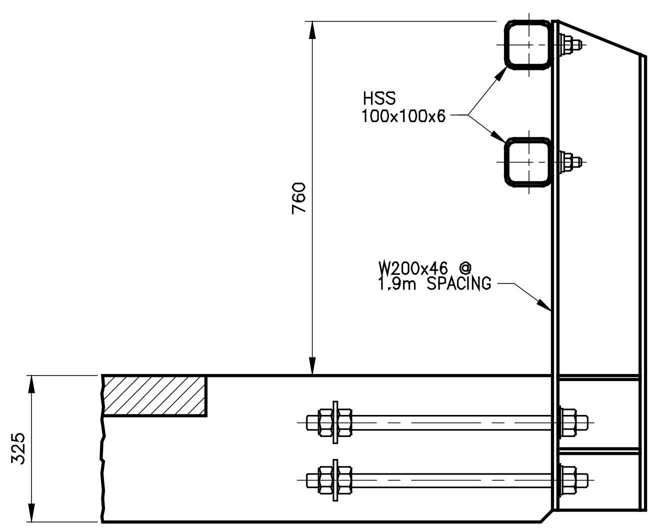

FIGURE 10.1.3.1(a) BOX BEAM GUIDE RAIL – SIDE MOUNT (TL-2)

b. Thrie beam guide rail – side mount (SS10-42A)

The system in Figure 10.1.3.1(b) is based on the crash tested *Oregon Side Mounted Thrie-Beam* bridge railing. The Oregon side mounted system consists of standard “Thrie Beam” elements mounted on standard structural steel posts. It is ideally suited for cast in place and precast slab superstructures with at least 400 minimum slab depth. It should be noted that the “W” shape steel beam guide rail used in Ontario is not the same as the ”thrie” beam section. Currently there are no crash tested bridge rail systems available incorporating the “W” shape steel beam.

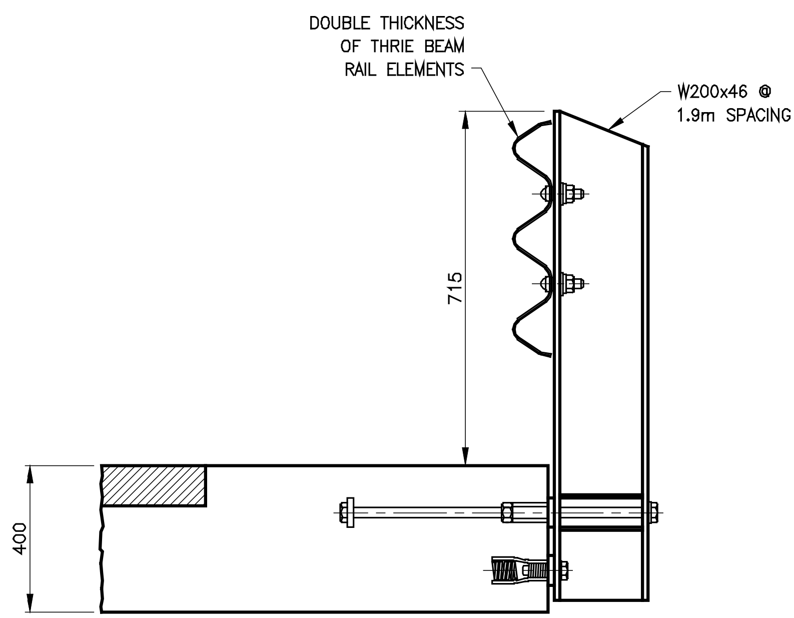

FIGURE 10.1.3.1(b) THRIE BEAM GUIDE RAIL – SIDE MOUNT (TL-2)

c. **Thrie beam guide rail – timber deck** (SS10-43A)

The system in Figure 10.1.3.1(c), for longitudinal timber bridge decks, is based on the *Steel System-Thrie Beam on Steel Posts* bridge railing crash tested for the US Department of Agriculture Forest Service. This in turn is an adaptation of the *California Thrie Beam* bridge rail modified for timber bridge decks. It consists of a thrie beam connected to standard structural steel “W” shape posts and spacer blocks side mounted on the bridge deck. The steel system is connected to the deck with high strength bars. Material costs are more economical than longitudinal glulam and timber post alternatives.

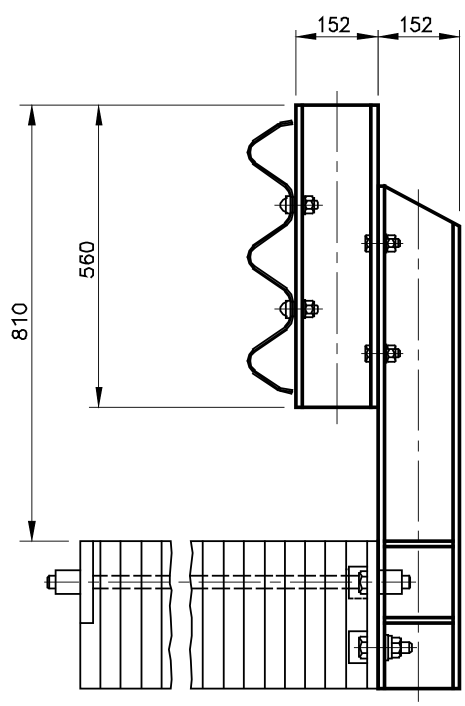

FIGURE 10.1.3.1(c) THRIE BEAM GUIDE RAIL – TIMBER DECK (TL-2)

2) Test Level 4 (TL-4)

The following barrier types are standards used by the Ministry for TL-4:

a) **Barrier wall with railing** (SS110-54/58/91)
Barrier wall without railing (SS110-80)

The system in Figure 10.1.3.2(a) is based on the crash tested *32-inch (813 mm) F-Shape Bridge Railing.* It is constructed of reinforced concrete and this type is the most common rigid traffic barrier in use today on both roadways and bridges. F-shape does not refer to the shape of the barrier but merely to the crash test designation. Its popularity is based on its generally effective performance as a barrier, particularly with its re-directional capabilities, and also its low maintenance costs. The concrete barrier requires virtually no maintenance for most hits. The lower sloped face redirects vehicles without damage under low-impact conditions. During moderate to severe impacts, some energy is dissipated when the vehicle is lifted off the pavement. The loss of tire contact with the pavement also aids redirection. In crash tests, the F-shape has proven to be more successful than the New Jersey shape in preventing rollover for small vehicles. The barrier may redirect or contain heavy vehicles but it was not designed for this purpose. Therefore, it is most suitable for highways carrying traffic with low heavy truck volumes.

A handrail is mounted on top to provide a combination railing for maintenance workers and occasional pedestrians on bridges without sidewalks. The handrail also provides some aesthetic benefit. The barrier wall is not to be used on bridges with sidewalks, as it provides no extra advantage when compared to a concrete parapet.

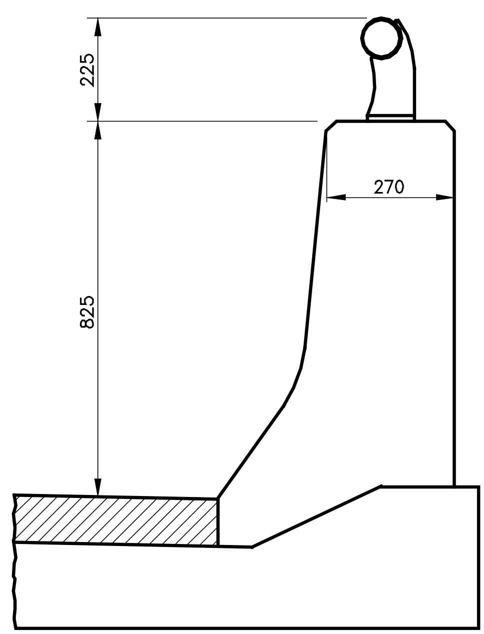

FIGURE 10.1.3.2(a) BARRIER WALL WITH RAILING (TL-4)

b) **Parapet wall with railing** (SS110-56/57/59/90/97/98/104/105)
Parapet wall without railing (SS110-81/106)

The system in Figure 10.1.3.2(b) is based on the crash tested *32-in (813-mm) vertical concrete parapet.* It offers a simple to build reinforced concrete alternative to the F-shape railing. Vertical concrete walls do not have the energy management feature of the F-shape, but crash test have demonstrated that they perform acceptably as traffic barriers. Because vehicles are not lifted or tilted, all four wheels tend to stay on the ground and all the energy absorption upon impact goes into the crushing of the vehicle. Therefore damage to a vehicle on impact with the parapet is likely to be more severe compared to the F-shape and redirection not as smooth. Potential rollover is minimised, however, with a vertical face.

A handrail is mounted on the top to provide a combination railing for maintenance workers and for bridges with sidewalks.

Where width is a premium on bridge decks such as on rehabilitations the narrower width of the parapet provides an advantage over the F-shape.

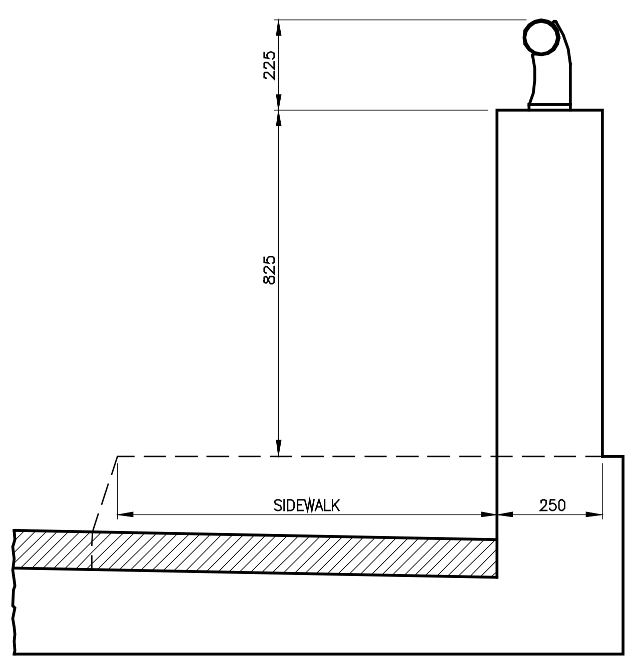

FIGURE 10.1.3.2(b) PARAPET WALL WITH RAILING (TL-4)

(c) Box beam guide rail on curb (SS110-39/44/48)

The system in Figure 10.1.3.2(c1) is based on the crash tested *New England Transportation Consortium 2-Bar Curb Mounted Bridge Rail.* The system in Figure 10.1.3.2(c2) is based on the crash tested *Massachusetts Type S3 Curb Mounted Bridge Rail. These systems* are constructed of standard structural steel W section posts and two or three HSS rails, and offer a good performing lightweight and open ("see through") rail alternative to the concrete barriers outlined above. Even though these rails are acceptable in most applications they are not recommended for use on high speed and limited access highways. For these cases the F-shape is recommended, as it is better at redirecting errant vehicles and requires less maintenance. The systems are usually used with concrete end posts for connection to the approach railing system. An alternative end connection between the box beams and approach steel thrie beam guide rail has been developed to accommodate user needs.

In general, these systems are suitable for vehicular applications, however, the Massachusetts system may be used for vehicular/pedestrian applications if pickets are included.

Because it offers one of the most open railings at this test level, it is most suitable for scenic and rural sites.

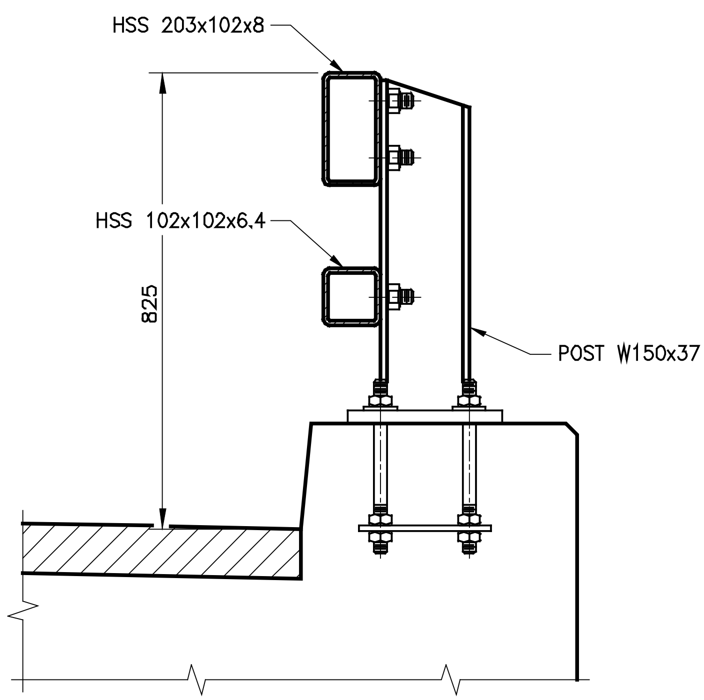

FIGURE 10.1.3.2(c1) TWO TUBE RAILING ON CURB (TL-4)

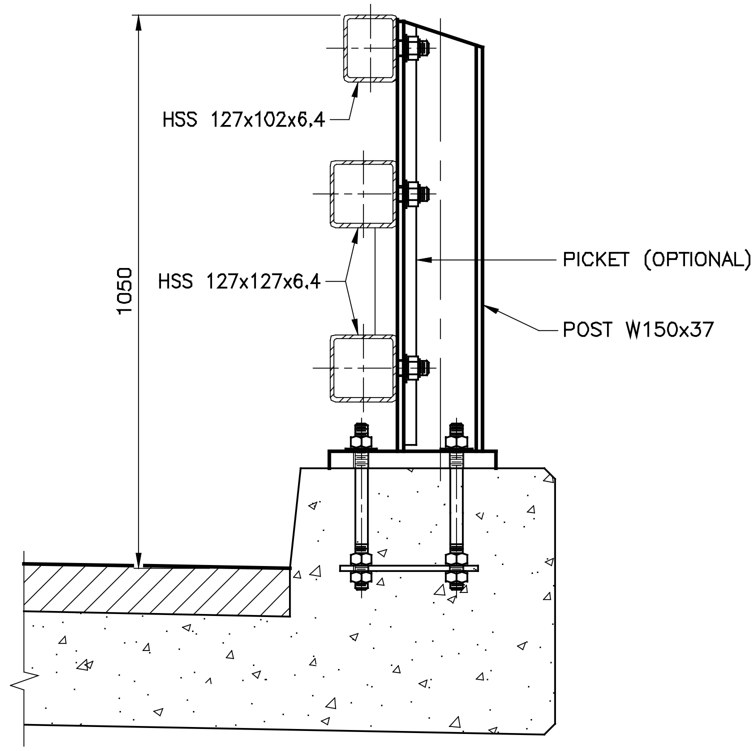

FIGURE 10.1.3.2(c2) THREE TUBE RAILING ON CURB (TL-4)

(d) Box beam railing on sidewalk (SS110-46/49)

The system in Figure 10.1.3.2(d) is based on the crash tested *New England Transportation Consortium 4-Bar Sidewalk Mounted Bridge Rail.* It is constructed of standard structural steel W section posts and four HSS rails and offers a good performing lightweight and open (“see through”) rail alternative to the concrete parapet wall on sidewalk with railing outlined previously.

This system is suitable for vehicular/pedestrian applications. Because it offers one of the most open railings at this test level, it is most suitable for scenic and rural sites.

Although this railing satisfies all the current requirements of the CHBDC with regard to clear spacing between the rails, the ladder like orientation of the horizontal rails make it more inviting to climb for little children. Consequently, a different system should be used when the structure is located near public schools and where the anticipated pedestrian traffic includes little children.

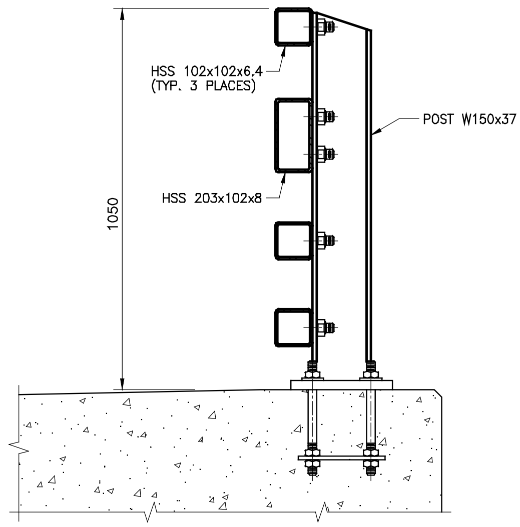

FIGURE 10.1.3.2(d) FOUR TUBE RAILING ON SIDEWALK (TL-4)

3) Test Level 5 (TL-5)

The Ministry currently has two barrier/railing systems that satisfy the TL-5 requirements. An F-shape barrier without railing and a system consisting of box beam railing on a concrete parapet wall.

These railing systems provide the maximum level of protection, in the event of a collision, for which the Ministry has a standard. Barriers crash tested to a higher standard than NHCRP 230 i.e. NHCRP 350 or for special cases such as for heavy trucks are available, and details of these may be found on the FHWA web site.

a) Barrier wall without railing (SS110-61/92)

The system in Figure 10.1.3.3(a) is based on the crash tested 4*2-inch (1.07 m) F-Shape Bridge Railing.* This railing system is very similar to the F-shape TL-4 concrete barrier in that the front surfaces and its construction are identical except for its height. The crash test characteristics are similar to the F-shape TL-4 barrier except that the extra height reduces potential rollover for impacting vehicles.

This railing system is not for use on sidewalks even though it meets the code requirements for pedestrians.

The system in standard drawing SS110-92 is based on the crash test done by Ryerson University at TTI on F-shape TL-5 barrier incorporating GFRP bars with anchor head. The crash test was performed in accordance with MASH TL-5 which is equivalent to TL-5 of NCHRP 350.

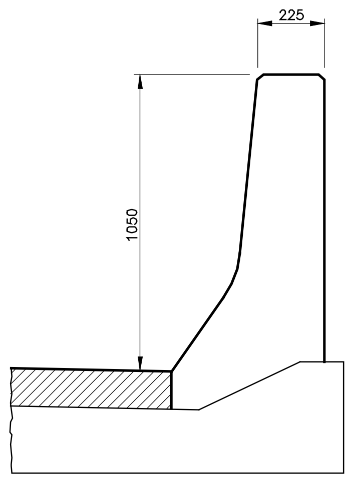

FIGURE 10.1.3.3(a) BARRIER WALL WITHOUT RAILING (TL-5)

b) Parapet wall with two tube railing (SS110-96)

The system in Figure 10.1.3.3(b) is based on the *PA Bridge Barrier* from Pennsylvania DOT. It was accepted by FHWA as a TL-5 barrier designation. It consists of a concrete parapet with metal railings mounted on top. The parapet facilitates transfer of post loads into the deck and the metal railings portion permit visibility through the railing. It offers a semi-open system alternative to the solid concrete barrier mentioned above.

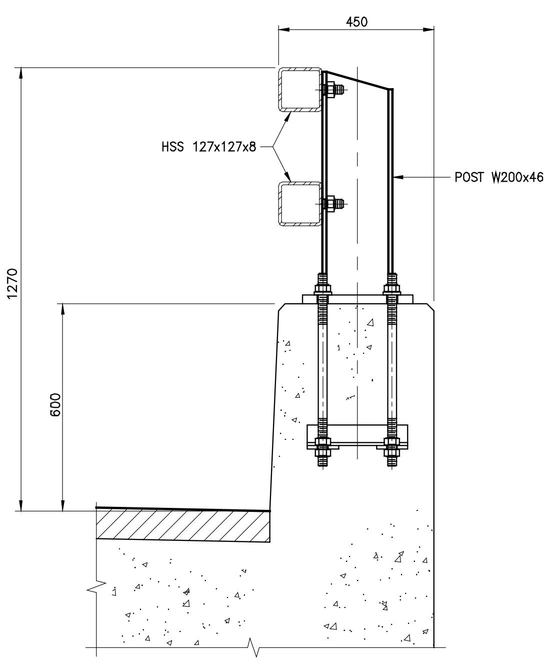

FIGURE 10.1.3.3(b) PARAPET WALL WITH 2 TUBE RAILING (TL-5)

10.1.4 BRIDGES WITH PEDESTRIAN SIDEWALKS

Barriers installed on pedestrian sidewalks should have a handrail. The top of the handrail should be at a minimum height of 1050 mm above the top of sidewalk. This handrail provides a safety “grip” for pedestrians in case they slip, makes it difficult for people to walk on top and adds some aesthetic value.

The *Four Tube Railing On Sidewalk* (SS110-46/49) *and Parapet Wall Wth Railing On Sidewalk* (SS110-57/97/98/105*)* are the MTO railing systems, currently available, for use on sidewalks.

The *Barrier Wall Without Railing TL-5* (SS110-61/92) railing system is not for use on sidewalks even though it meets the code requirements for pedestrians. A major concern is the barrier’s effectiveness from vehicles vaulting off the curb. However, in the uncommon situation where a sidewalk must be located adjacent to a roadway meeting TL-5 criteria, the following configuration should be considered:

roadway – barrier – sidewalk – pedestrian railing

When this configuration is used, interference with sight distance from interchange ramps or crossroads should be reviewed and the approach ends protected as for all barrier systems. Sidewalks located adjacent to highways shall be protected with a TL-5 barrier.

10.1.5 UNREINFORCED CONCRETE MEDIAN BARRIERS AND SHOULDER BARRIERS

Unreinforced barrier walls are no longer used on Ministry bridges. The justification for the use of unreinforced concrete median barriers was based entirely on testing and a history of acceptable performance, rather than on their being able to meet structural design requirements. Outside barriers on structures have always had to meet structural design requirements.

Barrier walls are not permitted to be slip-formed on structures because the horizontal reinforcement may produce voids beneath themselves during the slip-forming process. Moisture could collect in these voids and cause problems when the moisture would freeze.

Concrete median barriers on structures must be cast-in-place, and shall not be placed directly on waterproofing membranes and must be provided with lateral restraint to prevent movement. If the membrane is stopped at the barrier, it must be turned up the vertical face at the barrier base and into a groove. With this arrangement, the barrier must be dowelled to the deck so that small relative movement does not rupture the membrane. Median barrier details shown on standard drawings SS 110-62/63 meet these requirements and that of CHBDC.

10.1.6 BARRIER WALLS WITH ARCHITECTURAL FINISH

Bridge barriers are usually located where they are frequently seen by the public. An architectural finish on the wall surface provides a pleasant aesthetics while maintaining the proper structural function of the barrier.

A TL-5 concrete barrier wall with an architectural finish added to the outside face is shown in SS110-70 and SS110-93. The surface finish can be selected from the four standard patterns given in standard drawings SS110-71/72/73/74.

10.1.7 COMBINATION TRAFFIC/BICYCLE RAIL

This railing provides protection to both bicycles and vehicles. It shall be located on the outside face of bridges. The system shown in standard drawings (SS110-82/83/84/85) is developed based on the flush mounted combination traffic/bicycle rail system from Oregon DOT that was accepted by FHWA as a TL-4 barrier. It consists of a concrete parapet with two metal railings mounted on top. The overall height of 1370 mm meets the CHBDC requirements for bicycle barrier.

10.2.1 DETAILING OF STANDARD STEEL TUBE RAILING

The standard drawings permit detailing using either of two methods:

a. For structures on which the exact length of parapet or barrier railing can be readily established, e.g. individual structures on tangent, the spacing of the posts shall be shown on the drawings.

b. For other structures, e.g. structures on horizontal curves; structures or retaining walls in groups connected by railing, on which the exact rail length may not be readily established, the post spacing shall be determined by the contractor and should not be shown on the plans. A note to this effect should be given on the drawings.

Unless otherwise specified in the standards, the post spacing should be as close as possible to 3 m. The rail shall be supplied in length to be attached to a minimum of three rail posts and the rail splice shall be located within 600 mm from the post. The rail should be ordered in standard lengths satisfying the above mentioned criteria plus pieces for each side of the bridge of such a length as to give the exact rail length required.

Where the non-standard pieces are less than 2 m long, each non-standard piece shall be combined with the standard length to give two pieces less than the standard length.

If the curvature of the rail in position is sharper than 150 m radius, at least the first and last sections of the rails should be pre-bent and a note to this effect should be given on the drawings.

10.3.1 BARRIER WALLS ON FILL - PILES

The length of piles for barrier walls on fill shall be determined as follows:

a. Piles located between the structure and first expansion joint from the structure: Piles 1 m into existing ground, or minimum overall length 3 m and maximum overall length 6 m.

b. Other piles under barrier walls: Piles 0.5 m into existing ground or minimum overall length 3 m, maximum overall length 5 m.

Because of the high cost of providing piles under barrier walls on fill, the designer should investigate all possible alternatives, such as carrying the normal two-sided concrete highway barrier up to the end of the structure or retaining wall, with the standard transition, where required.

10.3.2 BARRIER WALLS ON RSS

The CHBDC does not provide design details or guidelines for traffic barriers mounted on mechanically stabilized earth (MSE) structures (in the Ministry the term Retained Soil System (RSS) is commonly used for these types of structures). Furthermore, the CHBDC has increased the traffic rail impact load requirements for all test levels compared to the earlier OHBDC. Designing for these new loadings, and in particular at the TL-5 level, without knowledge of their distribution through the barrier and transfer to a structural slab and wall system can result in costly or over conservative designs using conventional design methods. This problem has been recognised in the USA, and the Transportation Research Board has carried out a NCHRP project “Design of Roadside Barrier Systems Placed on MSE Retaining Walls” in 2010 (NCHRP 663). Design guidelines for the barrier system were developed based on finite element simulation, bogie vehicle tests and full scale Test Level TL-3 crash test.

In Ontario the design of the current barriers on RSS walls has been based on the impact loads given in OHBDC. To avoid severe wall damage during vehicle impact, top mounted traffic barriers are connected integrally to continuous footings (normally called anchor slab or moment slab) that are independent of the RSS retaining walls. So far no unsafe performance or damage, in over 20 years of use on Ministry Highways, has been reported. Given that the TL-4 loadings in CHBDC are just marginally higher than the loading given in OHBDC, it was decided to use the CHBDC TL-4 loading, on an interim basis, for the design of both TL-4 and TL-5 traffic barriers on RSS retaining walls. Furthermore, in the USA, AASHTO generally accepts TL-4 loading for the majority of its applications on highways and freeways with a normal mixture of trucks and passenger vehicles and this also seems appropriate in Ontario for the majority of its highways. Therefore the current standard drawings (SS110-64/65/68/69/75) may continue to be used for barriers on RSS retaining walls.

The following requirements apply for traffic barriers on RSS retaining walls.

1. For a TL-5 traffic barrier the loading used shall be equivalent to the TL-4

loading as given in Table 3.7 and it shall be applied as indicate in Figure 12.1 of the CHBDC for the TL-4 barrier.

2. For a TL-2 and TL-4 barrier the appropriate loads given in Table 3.7 and applied as indicated in Figure 12.1 shall be used.

3. Top mounted traffic barriers shall be connected integrally to continuous footings (i.e. anchor slab, moment slab) and shall be independent of the RSS wall. The loading stipulated in (1) above shall be used for the design of the barrier footing.

4. A traffic barrier integral with the RSS crash tested to NCHRP 350 for the test level required, is acceptable as an alternative.

5. Consideration shall be given, where practical, to locating the RSS wall away from the traffic barrier.

10.4.1 REINFORCEMENT OF CONCRETE BARRIER WALLS ON STRUCTURES

The following requirements now apply:

a. Longitudinal reinforcement in concrete barrier walls must be continuous through construction joints.

b. Unsupported ends of barrier walls (including those at expansion joints) must, for a distance of 1 m from the unsupported end, be provided with double the amount of reinforcement required for moment for the remainder of the wall. This is normally done by doubling up the number of bars at the unsupported end thereby reducing the spacing to one-half of the normal spacing.

10.4.2 DUCTS IN CONCRETE BARRIER WALLS

The following must be considered for all bridges with ducts in the concrete barrier walls:

a. Junction boxes should not be located within 1 m from expansion joints, where the vertical steel is at 110 mm spacing.

b. The deflection cavity for the duct (located at bridge expansion joints) is 143 mm dia. x 150 mm deep. This would interfere with reinforcement if the cover were at the maximum tolerance of 70 $\pm$ 20 mm (90 mm). A note should be added stating:

   "ADJUST END BAR SPACING TO ACCOMMODATE DUCT DEFLECTION CAVITY FORMER".

c. On structures with expansion joint assemblies, especially joints such as modular joints (DSM 9.40.20), where the armouring is carried to the top of the barrier wall, provision must be made to allow the ducts and duct deflection cavity former to be placed.

11 RIGID FRAMES

11.1.1 RIGID FRAME, BACKFILL

Unless the abutment walls have been designed to withstand earth pressure without the deck in place, backfill should not be placed behind them until the deck is constructed. Therefore for most cases a note stating this should be shown on the contract drawings. A standard note to be shown on the general arrangement drawing is given in 2.5.7.

The footings of rigid frame bridges exert a horizontal thrust upon the foundation, as well as a vertical thrust. If the footings are free to rotate the frame is said to have hinged supports. When the rotation of the footing is prevented, the supports are fixed. Actually, the supports are rarely hinged or fixed, but the foundation conditions lie somewhere in the range between these two extremes: that is, the supports are restrained.

If the summation of the horizontal forces at the footing is not equal to zero (i.e. there is insufficient resistance against sliding) the remaining unbalance horizontal force will cause a moment at the top of the rigid frame that should be accounted for in the design.

Normally, rigid frame structures are to be designed assuming simultaneous earth pressure on both sides. It is essential in such cases that the general arrangement should bear the standard note (given in 2.5.7) under "Construction Notes", on the right-hand side of the drawing.

The standard note, or a shorter note, e.g., from "Backfill" to "abutment", in the above note, must also appear on the preliminary version of the general arrangement.

When essential due to site access problems, a structure may be designed for earth pressure on one side. This must be stated as a requirement in the planning report, or in correspondence before the preliminary drawing is approved. When a structure is designed for earth pressure on one side, the general arrangement shall bear the following note under "Construction Notes" instead of the standard note:

"BACKFILL BEHIND (designate, e.g., "the north", "either", etc.) ABUTMENT MAY BE COMPLETED BEFORE BACKFILLING BEHIND THE OTHER ABUTMENT".

If the design of the abutment wall requires that it be supported during construction (e.g. for stability) a note to this effect should be shown on the general arrangement drawing under “Construction Notes”.

11.1.2 EARTH PRESSURE

Rigid frames and other structures where the deflection of the abutment is prevented by the propping action of the deck shall be designed for the at-rest earth pressure.

11.1.3 DRAINAGE

The provisions of 5.2.1(b) to (e) inclusive apply to the legs of rigid frame structures.

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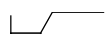
12 REINFORCING

12.1.1 GENERAL

For bridges with decks that are waterproofed, carbon (black) reinforcing bars shall be used in the deck except in the locations identified in section 12.1.3, where Premium Reinforcing materials (see section 2.8.2) shall be used.

12.1.2 REINFORCING STEEL BAR - IDENTIFICATION

Reinforcing bars shall be designated as illustrated in the following example pertaining to black steel reinforcing:

15M @ 300 

which denotes size 15 metric bars spaced at 300 mm, centre-to-centre, with the indicated shape. M is the metric bar size identifier.

Some examples of bar designation for black steel reinforcing, illustrating the above, are as follows:

15M

15M @ 300

20-15M @ 300

When the required bar shape is clear on the plan or section, the shape need not be given.

The bar size must always be given, but the bar spacing is not required to be given if they are specified as "equally spaced" within a clearly defined length or width on the contract drawings.

Where the length over which they apply can be calculated, or the distance is given, the number of bars is not required to be shown.

The quantity, size and spacing of bars should be given in situations when the extent of the bars is unclear, or it is simpler to do so.

The reinforcing schedules and placing drawings, which are prepared by the contractor, will contain bar marks for identification purposes.

12.1.3 PREMIUM REINFORCING – WHERE REQUIRED

Premium Reinforcing materials are as defined in section 2.8.2. of this Manual. For waterproofed decks carrying AADT less than 50,000 , Premium Reinforcing shall not be used in the deck except as specified in this clause. For larger traffic volumes, any additional use of Premium Reinforcing shall be justified by a life-cycle financial cost-benefit analysis.

Premium Reinforcing shall be used in locations vulnerable to salt-induced corrosion. In those locations, bars within 100 mm (e.g. cover specified as 125 $\pm$ 25 mm) of the surfaces shall be of Premium Reinforcing unless the surface is permanently covered with at least 500 mm of soil or water. Table 12.1.3 provides a summary of Premium Reinforcing requirements for surfaces of structures.

Other than in proximity to expansion joints, in the locations shown on structural standard (SS) drawings, stirrups from standard precast beams that project into deck slabs that are 200 mm or more in thickness need not be of Premium Reinforcing material.

Fig. 12.1.3(a) to (d) illustrates the extent of Premium Reinforcing for selected locations described in Table 12.1.3.

Premium Reinforcing is not required for selected components or structures that are covered by specific standards and that have a design life less than 50 years; such as footings of sign support structures and footings of high mast pole structures.

For replacement of concrete traffic barrier, Premium Reinforcing materials are not required if the remaining life of the deck is less than 35 years.

TABLE 12.1.3: Premium Reinforcing Requirements for Component Surfaces within Splash Zone

Component Surface	Stainless Steel	GFRP
• Top surfaces of bridge decks without waterproofing, extending partially around and below deck; ballast walls; and approach slabs	Yes	Yes
• All surfaces of TL-4 barrier walls and parapet walls	Yes	Yes
• All surfaces of sidewalks, medians and curbs	Yes	Yes

Component Surface	Stainless Steel	GFRP
• Surfaces of abutments, piers and retaining walls that are exposed to roadway drainage or dripping. This includes surfaces below sealed or unsealed joints, below deck drain outlets, and below overhanging features from which dripping may occur. “Below” should be taken to mean within a vertical cone having an apex angle of 45 degrees or likely to receive run-off from a surface within such a cone	Yes	Yes
• Exposed faces of abutment walls, tunnels/retaining walls*** within 7 m horizontally and 5 m vertically of an existing or future roadway measured from the edge of the nearest travelled lane.	Yes	Yes
• Side and end surfaces of pier shafts within 10 m horizontally and 5 m vertically of an existing or future roadway measured from the edge of the nearest travelled lane	Yes	Yes
• All surfaces of TL-5 barrier walls and parapet walls	Yes*	Yes*
• Top surfaces of expansion joint end dams including those at sleeper slabs supporting the end of the approach slabs	Yes	No**
• Surfaces of columns within 10 m horizontally and 5 m vertically of an existing or future roadway measured from the edge of the nearest travelled lane. All reinforcement in the column should be considered, including dowels from the footing.	Yes	No**

Component Surface	Stainless Steel	GFRP
Pier caps are exempt from this requirement except at location below expansion joints as stated below		
• Bearing seats and sides of pier shafts and columns, including pier caps, below expansion joints within 5 m measured vertically from the bearing seat	Yes	No**
• Top and side surfaces of bases for pole and sign structures that are attached to bridges	Yes	No**
• Front surface of ballast wall and top surfaces of bearing seats and pedestals for bridges with expansion joints	Yes	No**
• For semi-integral abutment bridges: All surfaces at and within 750 mm of the joint between the deck and wingwall. (see Figure 12.1.3(d) for examples)	Yes	No**

* Use stainless steel where AADT is greater than 100,000 and where deck/shoulder width is narrow, precluding safe work zone if repair to barrier wall is required. For other situations, use GFRP.

** GFRP is not specified for these elements due to extensive amount of bent bars or spirals required.

*** Includes RSS walls with concrete facings. The designer shall specify which RSS walls in the contract require Premium Reinforcing.

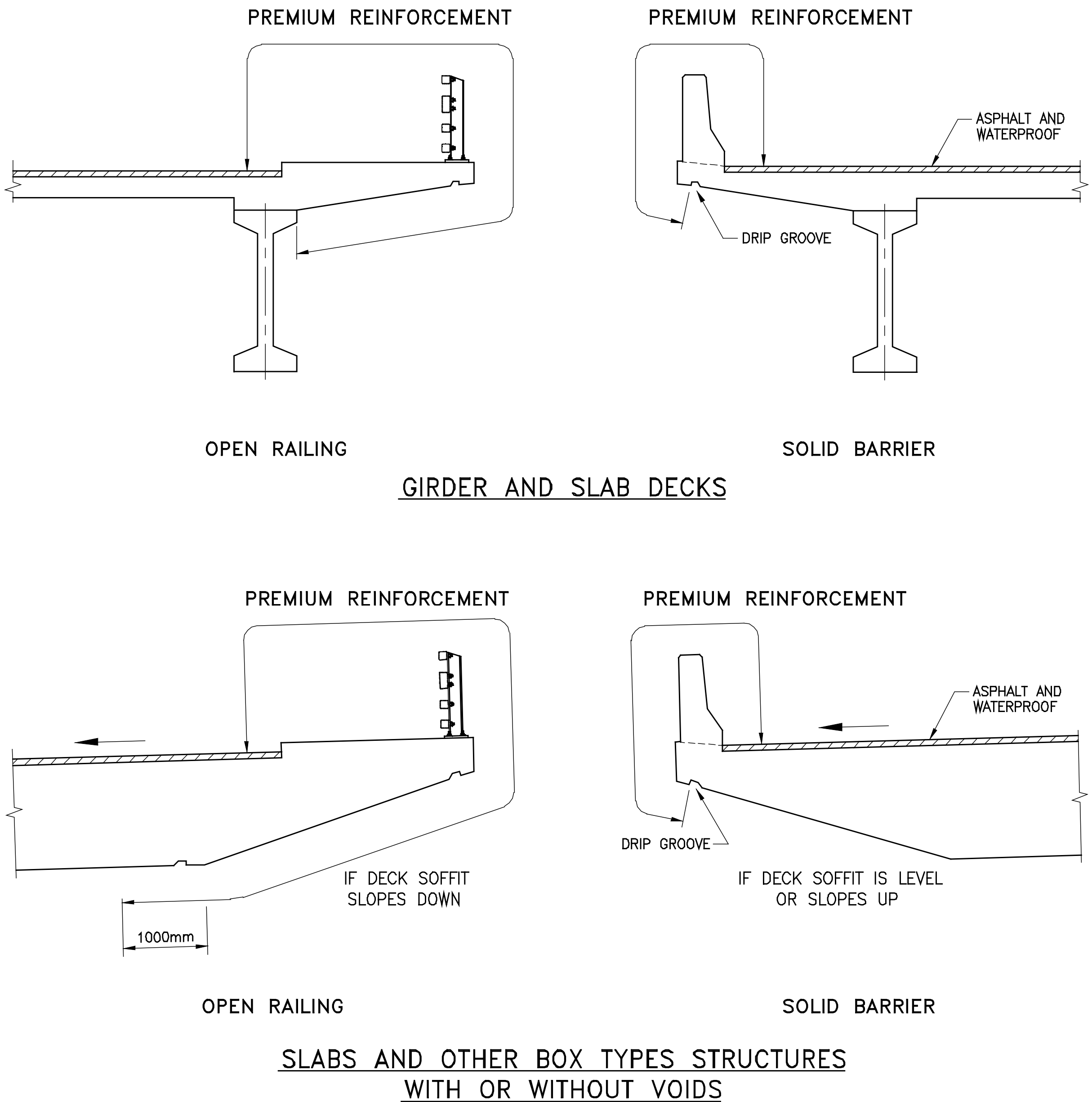
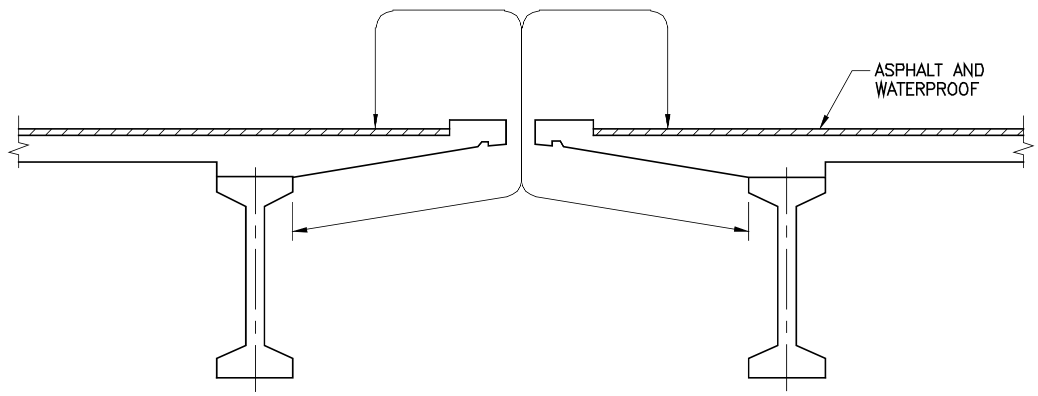
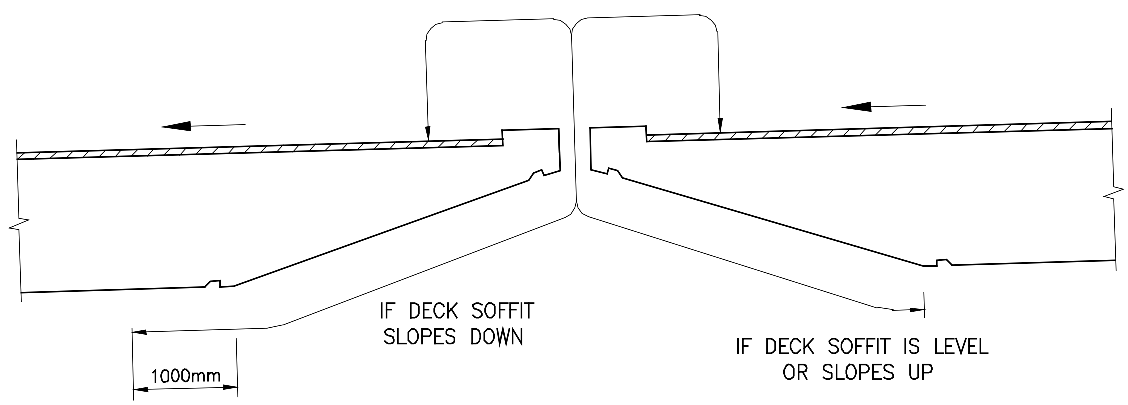


FIGURE 12.1.3(a) PREMIUM REINFORCEMENT BELOW JOINTS & RAILINGS



GIRDER AND SLAB DECKS



SLABS AND OTHER BOX TYPE STRUCTURES
WITH OR WITHOUT VOIDS

FIGURE 12.1.3(b) PREMIUM REINFORCEMENT BELOW JOINTS & RAILING

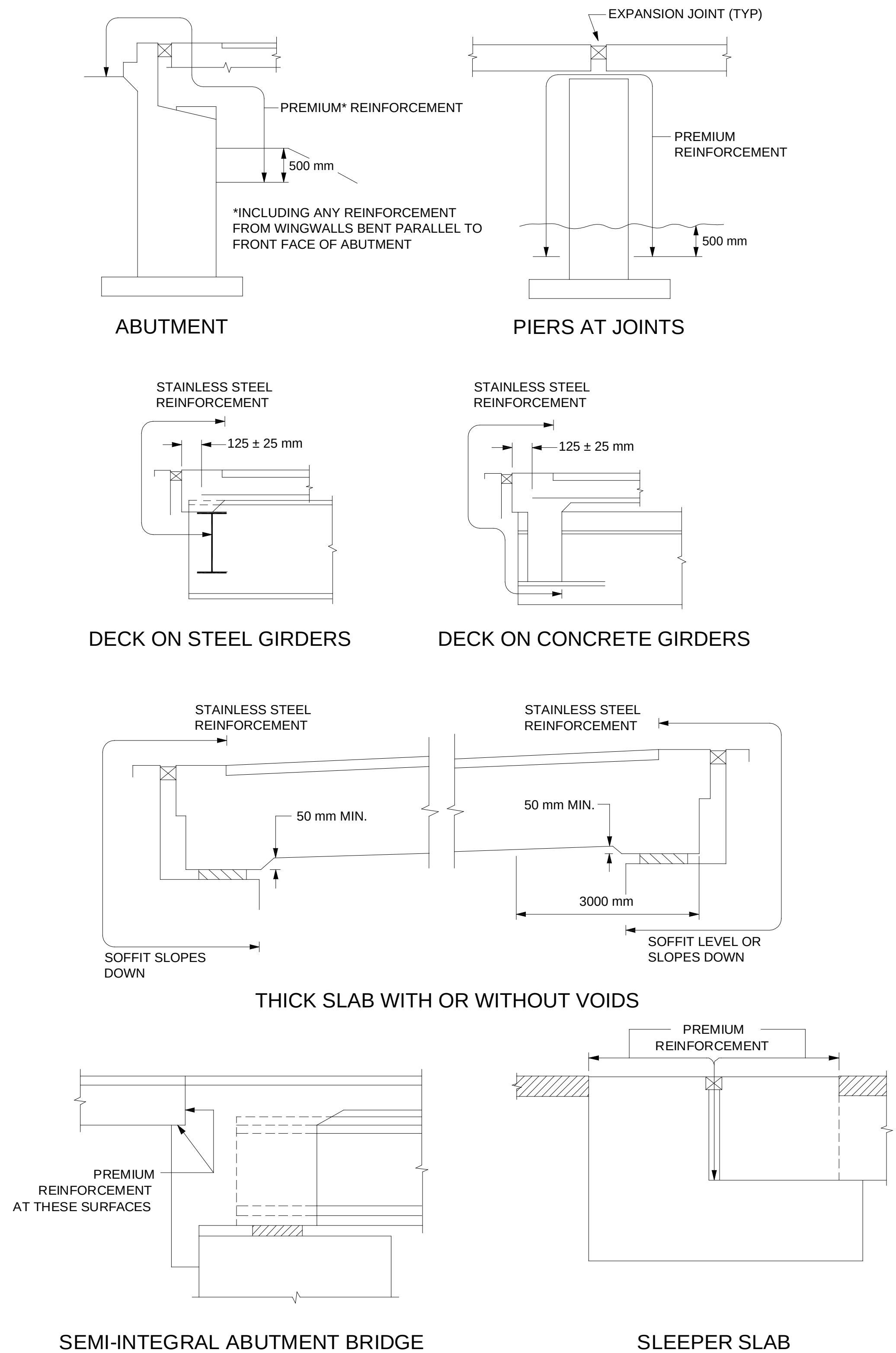


FIGURE 12.1.3(c) PREMIUM REINFORCEMENT BELOW JOINTS & RAILINGS

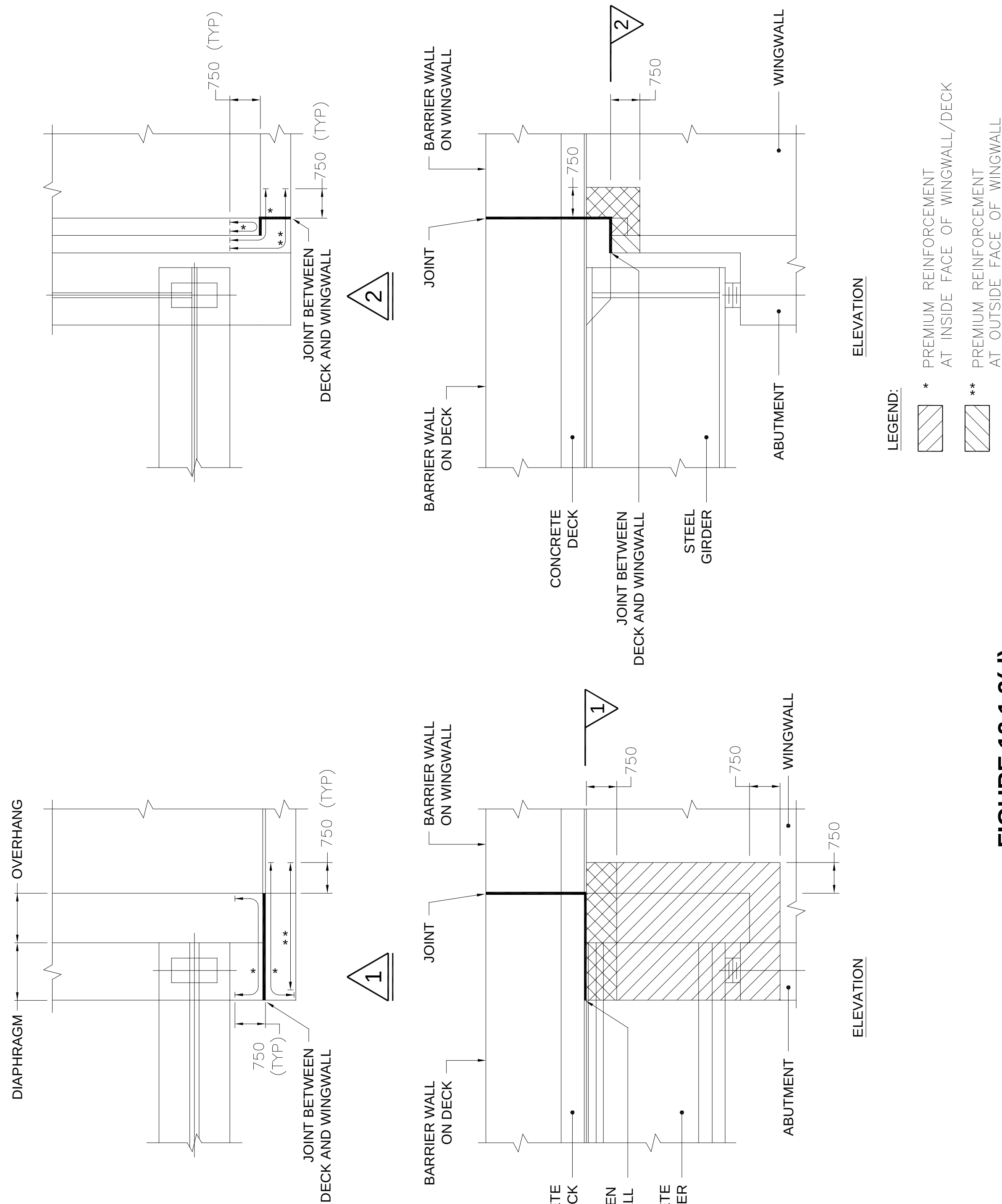


FIGURE 12.1.3(d)

12.1.4 PREMIUM REINFORCING - IDENTIFICATION

Prefix identifiers, as specified below, shall be used with Premium Reinforcing bar designations. A prefix identifier shall be regarded as an inseparable part of the bar identification.

Stainless Steel Reinforcing:

Stainless reinforcing shall be prefixed by the letter S. For example, a metric, 15 mm diameter, stainless steel reinforcing bar would be denoted as S15M.

GFRP Reinforcing:

GFRP reinforcing of grade I, grade II, and grade III shall be prefixed by GI, GII, and GIII, respectively. For example, a metric, grade II, 15 mm diameter, GFRP reinforcing bar would be denoted as GII-15M.

12.2.1 REINFORCING STEEL FOR CONCRETE CULVERTS

Reinforcing steel quantities for all cast-in-place concrete culverts in a contract are combined and included a separate lump sum tender item for each culvert. However, when the total quantity of reinforcing steel for all concrete culverts in a contract is less than 5 tonnes, the reinforcing steel will be included in the concrete item "Concrete in Culverts" and there will be no separate tender item for reinforcing steel.

12.3.1 REINFORCING - LIMITING DIMENSIONS

The normal mill length for reinforcing steel bar stock is 12 m for size 10M, and 18 m for all other bar sizes. These lengths should never be exceeded.

The shipment by truck of bars longer than 15 m requires an uncommon type of vehicle, and should be avoided unless there is a considerable economic advantage.

Bent bars shall, when laid flat, fit into a rectangle having dimensions not greater than 20 m by 2.4 m.

Length and shipment limitations for GFRP reinforcing should be discussed with manufacturers if they affect the design.

12.3.2 USE OF SIZE 10M REINFORCING BARS

Size 10M bars are too flexible for most applications, particularly in deck slabs. Size 10M bars shall not be used in deck slabs; their use should be restricted to small sections, such as barrier walls and precast units, where supporting stirrups are close together.

12.3.3 REINFORCING STEEL - AVAILABILITY

Size 45M and 55M reinforcing steel bars are not commonly required within the reinforcing steel industry. Fabricators cannot economically justify stocking these bars for which there is a low demand. As a result, a premium may be paid, and delays possible, if these bars are specified. It is recommended that these bar sizes be avoided wherever possible.

12.4.1 SPLICING OF REINFORCING BARS

OPSS 905.03 lists and describes the following six types of mechanical connectors for reinforcing steel bars:

a. Filled Sleeve Type

b. Sleeve Swaged Coupler Type

c. Threaded Coupler Type

d. Hot Rolled Thread Bar Coupler Type

e. Forged Bar Coupler Type

f. Form Saver Type

Mechanical connectors of carbon steel shall be supplied in accordance with DSM 9.65.58. As a DSM for mechanical connectors of stainless steel reinforcing has not been developed, when mechanical connectors are required for splicing stainless steel reinforcement, it should be stipulated that stainless steel mechanical connectors shall be supplied by manufacturers listed in DSM 9.65.58. Mechanical connectors are not available for splicing of GFRP reinforcing.

Minimum cover requirements apply to the splices and mechanical connectors.

Where required, mechanical connectors and splices shall be designed for their specified fatigue loading.

12.5.1 REINFORCING SCHEDULES

The following procedures shall be adopted for reinforcing schedules:

1. Rebar schedules shall not be prepared and provided by the designer as part of the contract documents.

2. Individual bar marks shall not be used on the contract drawings because contractors produce their own rebar schedules and placing drawings.

3. Review of rebar schedules and placing drawings shall be done as detailed in section 12.5.3.

4. The contract drawings shall be prepared with sufficient rebar detail and other relevant information such that rebar schedules and placing drawings

can be independently and correctly produced by the fabricator. For descriptions of detailing, see section 12.5.2.

If special circumstances require the designer to prepare the reinforcing steel schedule, the contractor must be made aware that MTO does not guarantee the accuracy of the bar lists, and that the contractor is responsible for verifying all the data in the schedules.

12.5.2 DETAILING REINFORCING ON CONTRACT DRAWINGS

1. The structural designer shall ensure that the contract drawings clearly show all required detailing information.

2. Reinforcing bars shall be identified according to sections 12.1.2 and 12.1.4

3. Minimum detail shall include the size, shape, spacing and placing limits for individual bars, and if necessary, the number of bars. Detailing should be adequate to eliminate ambiguity and misinterpretation. Dimensioned sketches of bars should be provided when required.

4. Where multiple layers of reinforcement exist, the bar sizes in the outer layer shall not be less than any inner layer, and the bar spacing (linear for rectangular sections and angular for circular columns) shall not be greater than in any inner layer.

5. Lap lengths for reinforcing steel (tension or compression), not indicated on the contract drawings, shall be Class B as per CHBDC. Other lap lengths, where required, shall be indicated on the drawings. For GFRP, these lap lengths shall be as modified according to the requirements of CHBDC.

6. Reinforcing steel bar hooks shall be minimum length, as per SS12-1 of the Structural Manual, unless indicated otherwise.

7. Reinforcing steel stirrups shall have minimum hooks, as per SS12-1 of the Structural Manual, unless indicated otherwise.

8. Curved GFRP reinforcing is fabricated to radii specified by the manufacturer. Designers should be aware of manufacturers' recommendations and ensure that they are accounted for in the design. Because of instances of poor quality GFRP reinforcing and code strength limitations at "bend" locations, straight bars should be specified where possible.

9. Reinforcing tender items are lump sum bid items and the quantity shall not be listed on the contract Quantities-Structure drawing.

10. The structural designer shall forward the quantities of reinforcing items for carbon steel reinforcing, stainless steel reinforcing and GFRP reinforcing to the Regional Planning and Design. These quantities should be accurate to within $\pm$ 10%.

11. The requirements of the above notes 5 to 7 should be given as part of the general notes on the general arrangement drawing of all projects.

12.5.3 CHECKING OF REBAR SCHEDULES AND PLACING DRAWINGS

It is recommended that reinforcing bar schedules and reinforcing placement drawings be reviewed by the Regions on a selective basis, for the correct interpretation of the design drawings. The choice of structure to be checked should be based on the complexity of structure (e.g. post-tensioning, large skews), previous experience with fabricator/contractor, or the structure's critical importance. The Regional Structural Section should decide which structure shall be considered for review.

When a particular structure is selected, only critical areas and elements such as anchorage zones, cantilevers (decks, retaining walls), columns, areas with large size bars or other locations as determined by the designer are required to be checked. Both schedules and placing drawings should be checked together for the size of bars, shape, number and spacing. Individual dimensions and nominal steel need not be checked except where critical lengths, such as embedment lengths or anchorage requirement, etc. are given.

The above policy is followed selectively based on ongoing regional experience.

12.5.4 HOOKS AND BAR BENDS

Standard drawing SS12-1 have been updated to be in conformance with the CHBDC, and also to meet the minimum fabrication requirements of the edition of the RSIC Manual of Standard Practice that was effective at that time. This structural standard drawing is included in Division 4, section 1 of this Manual, and shall be attached to the full-size standard drawings in a contract. They are intended for the contractor’s use, in order to produce consistently accurate hooks and bar bends in black and stainless reinforcing steel. The GFRP fabricators should be consulted for all bend details and limitations.

13 BEARING ASSEMBLIES AND EXPANSION JOINTS

13.1.1 EXPANSION JOINTS IN DECKS

Bridge deck expansion joints should be of a sealed type covered by current Bridge Office Standards. The designer should make every effort to minimise the number of expansion joints along the length of structure. In all cases, the expansion gap shall be detailed parallel to the skew of the deck, for the full width of the deck. The resulting exposed acute-angled concrete edges shall be provided with 50 mm chamfers. Designers should also try to avoid skew angles of 32 to 38 degrees, inclusive, to minimise the chances of snagging snow plough blades which are usually set at approximately 35 degrees.

In addition to longitudinal movement of the superstructure, the effect of structure flexure on the closing and opening of the joint shall be considered.

The gap between the end of a deck and the ballast wall face must meet the requirements of the CHBDC. The gap between the underside of the deck and the bearing seat shall be large enough and accessible enough for cleaning. The drawings must not show the gaps left filled with material used in construction.

When specifying an expansion joint movement rating, only those movements which can occur after the joint has been installed shall be considered. Thus when specifying expansion joint movement ratings for rehabilitation projects, elastic shortening, hydration, shrinkage and creep effects should be neglected. Likewise for new prestressed concrete bridges, creep and shrinkage effects occurring prior to joint installation should be neglected. Joint installation can occur as many as 90 days after the completion of prestressing operations; the actual time to be used by the designer should be determined by consultation with the Region or Bridge Office and indicated on the expansion joint standard.

Because of their vulnerable location, bridging gaps between deck and superstructure elements, proper installation is critical in achieving expected long term performance of expansion joints. Important elements of the installation include: proper alignment, installation after paving, and epoxy injection under the armouring. Expansion joint assemblies are installed after the completion of paving operations. Installation after paving provides superior ride for vehicles, resulting in lower impact on the joint and its anchorage and superior durability.

Proper installation of expansion joint assemblies accounts for compaction of the asphalt wearing surface, by traffic, adjacent to the concrete end dams.

If a concrete strip is detailed as a "dam" between an asphalt wearing surface and an expansion joint, it should be wide enough to permit the placing of concrete through the gap between joint armouring and concrete dam armouring, but should not be less than 500 mm in width, either side of the joint. Weep holes through the deck are required at low points at these dams. Refer to OPSD 3349.100.

Straight reinforcing bars to be placed parallel to expansion joints on the concrete end dams shall consist of:

(a) for modular joints - two shorter bars lapped between the support boxes; and,

(b) for all joints - at least two shorter lapped bars which are to be threaded through anchor loops or other in-place reinforcing steel.

Joints should be specified on the drawings by reference to the appropriate "Designated Sources for Material List" number and, in the case of DSM 9.40 - Joints, by type. All types, structurally acceptable for the particular project, should be given.

When splicing of joint armouring is unavoidable, such as at construction staging, permissible splice locations must be shown on the drawings. Such locations should be at crown points, if possible, and in no case shall they be located near curbs, barrier walls, wheel paths or at any point where water is likely to pond. On skew bridges, when the approved splice is shown at a crown, the splice in the armouring should be shown parallel to the centreline of the traffic lane and not perpendicular to centreline of joint.

The material for strip seals shall be neoprene. Natural rubber as an alternative material is not permitted as MTO lab tests have found that the effects of ozone and oil swell tests were unacceptable.

13.1.2 APPROVED EXPANSION JOINT ASSEMBLIES

The expansion joint systems approved for use on new and/or rehabilitated structures are listed in Designated Sources for Materials List DSM 9.40 - Joints as follows:

<u>DSM NO. (DIVISION/APPLICATION/PRODUCT)</u>

DSM 9.40.18	Expansion, Injection Systems for Armouring
DSM 9.40.20	Expansion, Modular
DSM 9.40.24	Expansion, Strip Seals Anchored in Concrete, Type A
DSM 9.40.27	Expansion, Strip Seals Anchored in Concrete, Type C
DSM 9.40.30	Expansion, Strip Seals in Elastomeric Concrete, Type A
DSM 9.40.32	Expansion, Strip Seals in Elastomeric Concrete, Type C
DSM 9.40.33	Expansion, Strip Seals in Preformed Retainer

Guidelines for the application of these lists are given in 13.2.1 to 13.2.7.

13.1.3 EXPANSION JOINT ASSEMBLIES IN SKEWED BRIDGES

A plan and profile must be provided on the drawings for skewed expansion joints. Drawings of fabricated expansion assemblies shall show the following: crossfalls, break points, lengths between break points, total lengths, skew angles where appropriate, and location of approved splices in armouring where applicable.

When specifying an expansion joint assembly for a skewed bridge, the designer must be aware of the effect of the skew on the rating/performance of the joint.

Joint assemblies in bridges with skews should be carried through sidewalks, medians and barrier walls without horizontal change in direction wherever possible. A 50 mm chamfer shall be detailed on all exposed acute-angled concrete deck edges on skewed bridges.

Where this is not possible the horizontal change in direction should be effected at a location not less than 100 mm and not greater than 600 mm from the edge of the asphalt at the barrier wall.

A horizontal change in direction must NOT be located within 100 mm of a vertical change in direction since simultaneous bending of the seal in two planes is either physically impossible or likely to lead to leakage between the seal and the clamping device. Locating horizontal change as close as is practicable to the barrier wall reduces the modifications necessary to the substructure. The change in direction shall be effected by means of a 600 mm radius bend. The exact location of the radius bend should appear on the plan view of the structure on the contract drawings and on the contractor's shop drawings.

Structures having a skew of up to 15 degrees and over 45 degrees shall have joint armouring anchorage bars, on the deck side, detailed perpendicular to the expansion joint. Structures skewed from over 15 degrees up to 45 degrees shall use joint armouring anchorage bars, on the deck side, detailed 30 degrees offset from the perpendicular to the expansion joint. Anchorages on the abutment side of the joint shall be placed at right angles to the joint.

13.1.4 LONGITUDINAL JOINTS AND GAPS

Longitudinal joints exposed to traffic shall not be used without approval of the Structural Section. When used, they are required to accommodate movement demands from differential deflection and movement.

Twin bridges separated by a narrow gap shall be sealed to prevent the accumulation and passage of debris, snow, water and chlorides. Gaps between raised medians shall be detailed according to section 9.9.1.

13.1.5 CELLULAR SEALANTS

Closed cell cellular sealants shall only be used in unarmoured longitudinal joints.

13.1.6 COMPLETION OF STANDARD DRAWINGS

The following note on the expansion joint standard drawings must be completed by the designer:

"EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___ [1] AND SHALL HAVE A RATED TOTAL MOVEMENT CAPACITY OF _____ mm." [2]

---

1 The designer shall insert the number of the appropriate DSM list or Lists which are acceptable. Where DSM 9.40 - Joints are shown, the acceptable type or types must also be given, except when all types are acceptable.

2 The movement shown should be the required movement as determined by the Designer, calculated at Serviceability Limit States; this movement shall not exceed the rated movement of at least one of the joints in the type specified, and where possible, should not exceed the rated movement of at least one joint from each supplier in the type specified.

The movement ratings given in Designated Sources for Materials List DSM 9.40 were established from laboratory testing and to allow seal replacement at 25°C.

Where possible (i.e. where the full rated movement of the joint is not fully utilised), the "J" dimension at various temperatures shown on the standard drawings should be increased by 5 mm. This will have the effect of providing slightly more opening for future replacement of the seal.

13.1.7 FORCE DUE TO MOVEMENT OF MODULAR JOINTS

There is a force associated with the movement of modular joints that should be considered when designing abutments.

When a bridge contracts in the longitudinal direction due to a decrease in Temperature (as well as due to Creep and Shrinkage in prestressed concrete bridges), the modular joint responds by opening further to accommodate this movement. As the joint opens, the control springs in the equidistancing mechanisms are compressed, causing a corresponding resistance to the opening movement and thereby transferring this resisting force as a horizontal load to the top of the ballast wall.

The following assumptions and method is used in calculating the force due to the movement of modular joints:

- Two types of modular joints are presently used:

  (a) Box-Seal Modular: each seal opens from 20 mm to 80 mm; gap @ 15ºC = 35 mm

  (b) Strip-Seal Modular: each seal opens from 35 mm to 80 mm; gap @ 15ºC = 45 mm

- n = Number of seals in modular joint
- k_1 = Spring stiffness of a control spring = 0.15 kN/mm
- Number of control springs acting = Number of separation beams = Number of support bars = (n – 1)
- The opening movement per seal = Movement of each separation beam = 45 mm (box seal) (from 35 mm @ 15ºC installation temperature to 80 mm maximum at minimum temperature)
- Δ = Total movement of separation beams = (n – 1)(45)
- Stiffness of modular joint (springs acting in series) = K = k_1/(n – 1)
- Total Horizontal Force per support box = F = K(Δ)

Accordingly, for a box-seal modular joint with any number of seals:

$$\begin{aligned} F &= K(\Delta) \\ &= [k_1/(n-1)] \times [(n-1)(45)] \\ &= (0.15)(45) \\ &= 6.8 \text{ kN} \end{aligned}$$

Assuming an average spacing of 800mm c/c for support boxes, the resulting unfactored horizontal force would be 8.5 kN per metre length of ballast wall for box-seal modular. (6.8/0.8 = 8.5)

Therefore, the designer should apply an unfactored horizontal force of 8.5 kN/m length of abutment, for box-seal modular expansion joints (if seals are utilized to their full expansion potential) at the top of ballast wall, to account for the effect of modular expansion joint stiffness. For strip-seal modular expansion joints, this figure should be 6.6 kN/m. [(0.15)(35)/0.8 = 6.6]

At the time of supply of the expansion joint, the contractor must verify that the spring stiffness of the supplied expansion joint doesn’t exceed 0.15 kN/mm per spring; if it does, the substructure may have to be re-designed based on the actual expansion joint stiffness supplied.

13.2.1 MODULAR JOINTS

Modular joints are for bridges having total deck joint movements after joint assembly installation, measured parallel to the centreline of the highway, greater than 120 mm in one direction.

Available Modular joints can have a minimum of 3 to a maximum of 8 seals. The maximum movement of any one seal, measured parallel to the centreline of the highway, must not exceed 60 mm. Notwithstanding the above, modular joints should only be used as a last resort when no other type of expansion joint is suitable, or when other means cannot be found to accommodate the structure's anticipated movement. Refined methods of analysis are justified to more accurately predict deck joint movement when the use of modular joints is being considered.

Dimensions **F** and **D + F** in Figure 13.2.1(a) vary with the number of seals, and the minimum requirements are:

F = 250 mm MIN. at 15^{o}C (maintenance requirement)

D + F = 450 mm MIN. at 15^{o}C (for inspection and maintenance)

For post-tensioned concrete bridges, **F** and **D** should be calculated at 15^{o}C for the required joint size and movements due to creep, shrinkage and temperature fall occurring after time of joint installation. In lieu of more accurate data, the designer may assume joint installation occurs at 90 days after stressing of prestressed concrete bridges.

Dimensions **H** and **B** in Figures 13.2.1 shall be as follows:

					Seldom Used	
No. OF SEALS	3	4	5	6	7	8
B (mm)	675	760	835	915	995	1075
H (mm) MINIMUM	355	355	355	380	380	380

The width of blockout **B** depends only on the number of seals in the joint, while the depth of blockout **H** depends not only on the size of the joint (number of seals) but also on the supplier of the expansion joint.

When the ballast wall is corbelled at the top and the corbel is greater than 100 mm, the corbel reinforcing shall be designed by an appropriate method such as "strut and tie".

13.2.2 MODULAR JOINT SELECTION

1. Calculate the Design Movement "**D**", due to the sum of Creep + Shrinkage + Temperature Range.

   Creep and Shrinkage movements are from time of joint installation, i.e., from t = 90 days to infinity.

   Movements due to Temperature Range are from the sum of temperature fall to temperature rise.

2. Obtain the Serviceability Limit States design movement which is 80% of the above Design Movement.

   If the SLS Design Movement > 120 mm, use Modular Joint, otherwise strip seal (see 13.1.2 and 13.2.3 to 13.2.5) or sliding plate joints (see 13.2.8) may be used.

3. For Modular Joints, select joint size (number of seals required) based on the SLS Design Movement as provided in DSM # 9.40.20.

4. Select the dimension "**D**" based on the number of seals required.

5. Select dimensions "**B**" and "**H**".

No. OF SEALS	3	4	5	6	7	8
D @ 15^{o}C in mm	200	150	100	50	0	0
F @ 15^{o}C in mm	250	300	350	400	450	500

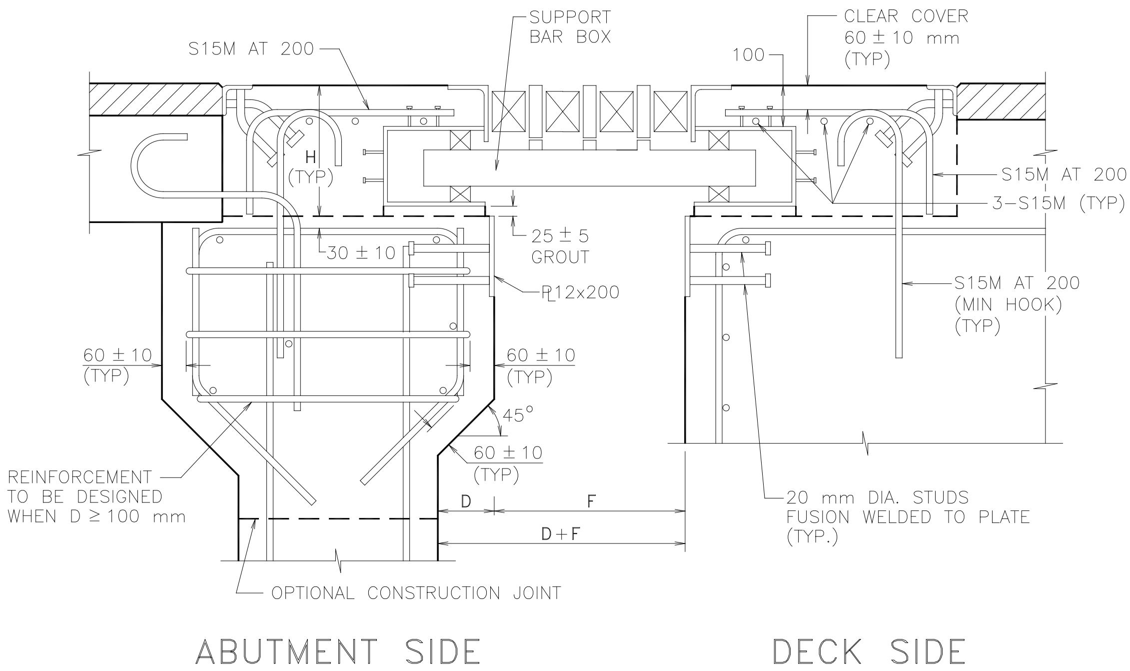


FIGURE 13.2.1(a) MODULAR JOINT DETAIL - SECTION AT BOXES

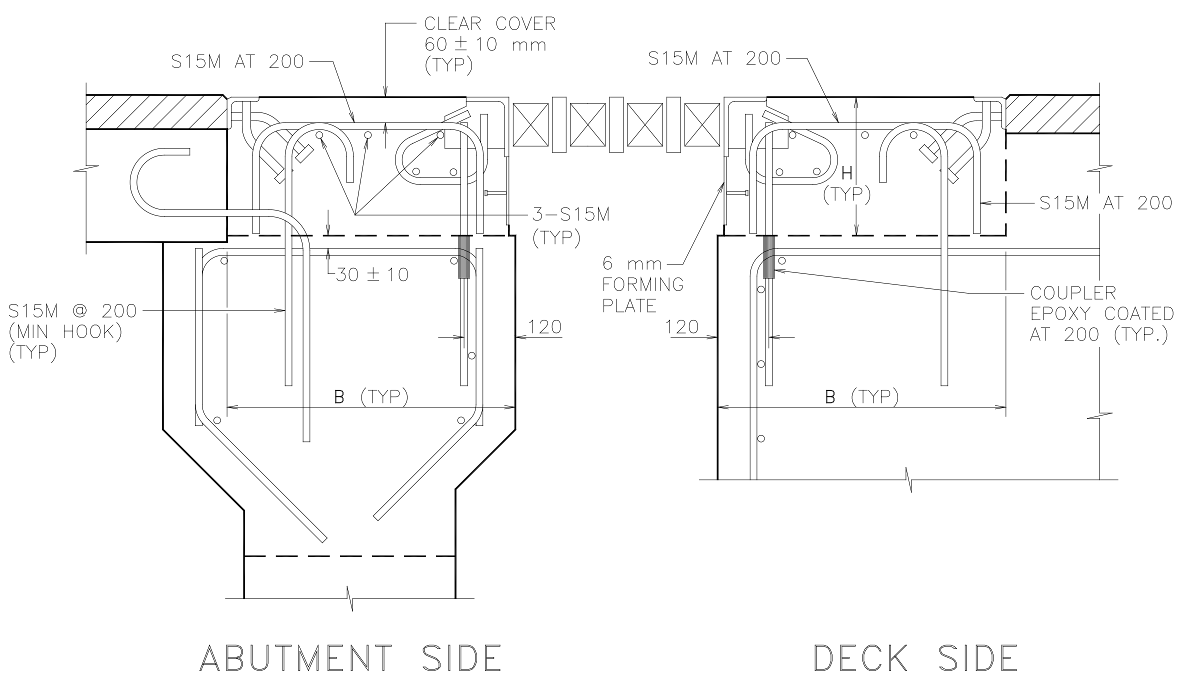


FIGURE 13.2.1(b) MODULAR JOINT DETAIL - SECTION BETWEEN BOXES

13.2.3 MODULAR JOINT SETTING

Having selected an expansion joint whose Range of gap rating (max. gap minus min. gap) is greater than or equal to the SLS Design Movement, the "J" gap dimension must be calculated at the assumed 15^{o} C construction temperature.

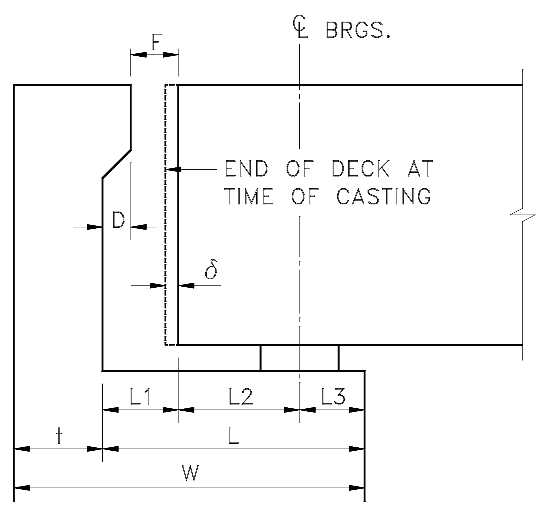
For prestressed concrete structures, "J" at 15^{o}C equals 0.8 (CR + SH + T_{fall}), where T_{fall} is the movement due to a temperature drop from 15^{o}C to the Minimum Effective Temperature used in design.

The maximum and minimum "J" dimensions must then be shown on the expansion joint drawing.

13.2.4 ABUTMENT WIDTH

Since large movements are expected when modular joints are used, the minimum width of abutment should be based on the distances shown in Figure 13.2.4. The effect of skew and minimum seating requirements for earthquake should also be considered.

At 90 days from casting of the deck, the gap width "F" (see Figure 13.2.4) at the level of the corner protection plates and at a temperature of 15^{o}C shall be equal to "J" but not less than 250 mm.



δ = the expected movement, at the end of the deck, due to Hydration + Elastic Shortening plus Creep and Shrinkage, from t=0 to t=90 days

L1 = Gap between ballast wall and end of deck at 90 days (Min. 450 mm)

L2 = Distance between centreline of bearings and end of deck at 90 days

L3 = Distance between centreline of bearings and face of abutment

t = Thickness of ballast wall (see 5.3.5 for minimum thickness)

W = t + (L1 + L2 + L3) = t + L

FIGURE 13.2.4

13.2.5 STRIP SEAL JOINTS ANCHORED IN CONCRETE

The joints in this list are for bridges having total deck joint movements calculated at SLS, measured parallel to the centreline of the highway, and after joint assembly installation, of 80 mm or less but not greater than the rated movement of the joint specified.

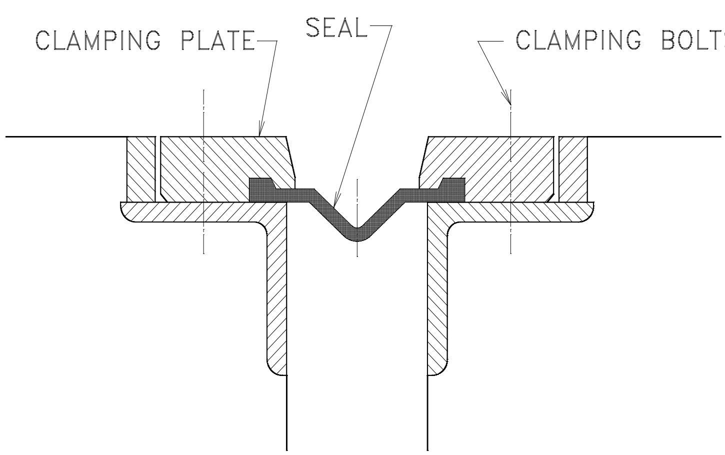
DSM 9.40.24 to 9.40.33 is subdivided into several types based on the method of seal retention used. General guidelines showing the characteristics of each type and the applications for which it should be considered, are given on the following pages.

It is the responsibility of the designer to select the appropriate type or types of joint in accordance with those general guidelines. All types of expansion joints on the DSM List have been approved by the Ministry and should be considered for application on structures. Where further guidance is required the Head, Regional Structural Section should be consulted.

Standard drawing SS113-11 covers anchorages and armouring for all types of expansion joints listed in DSM 9.40.24 to 9.40.33.

Strip Seals - Type A Steel Plate Clamping Device

Clamping Plate Subject to Direct Wheel Load



Characteristics:

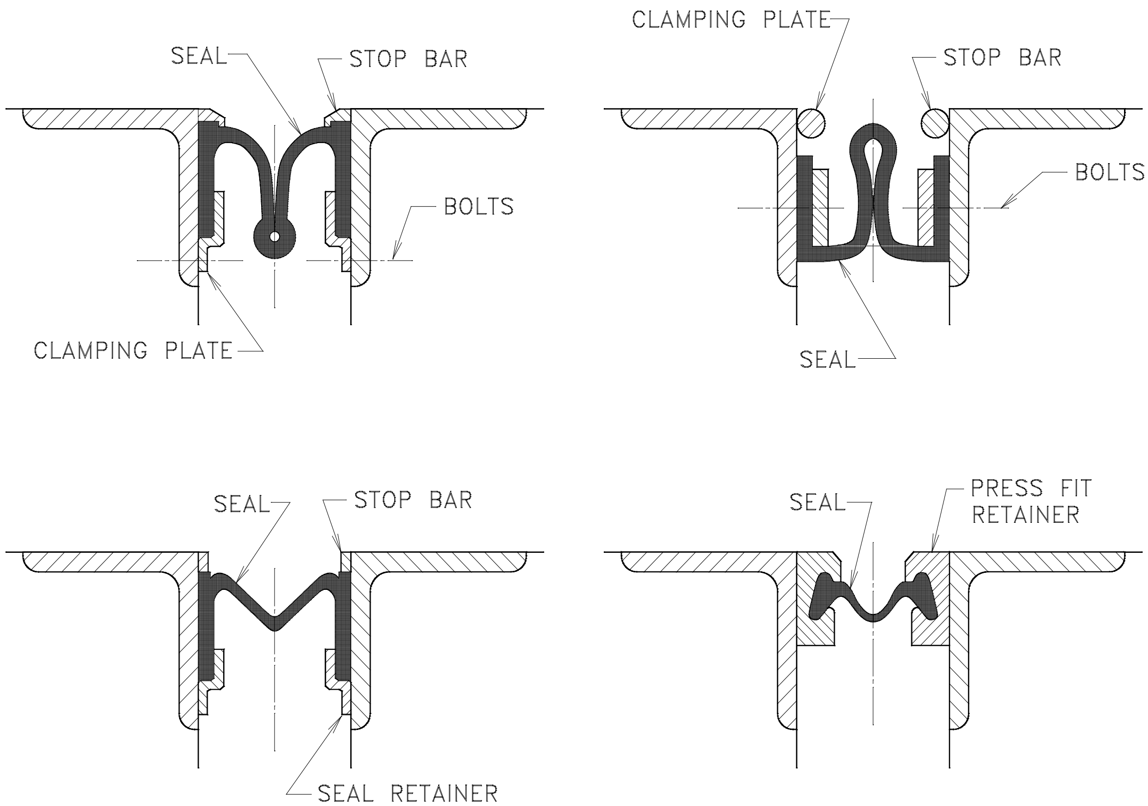
- Clamping plate directly supported.
- Few components.
- Excellent seal retention.
- Easy to install and replace seal.
- Direct access to clamping bolts and seal.
- Seal can be inspected completely and reused, if undamaged.
- Easy to modify for changes in elevation.
- High initial cost.

Application

Type A joints as per DSM 9.40.24 should be considered for all bridges and particularly for bridges which carry high volume freeway/arterial traffic (and especially when there is a high proportion of heavy vehicles).

Only Type A joints should be specified for bridges for which, in the opinion of the Head, Regional Structural Section, it is absolutely essential to minimise the frequency and duration of future lane closures.

Strip Seals - Type C Retainers and Stop Bars



Characteristics

- Good seal retention.
- Can accommodate change in direction in plan.
- Seal cannot be inspected completely without removing the seal.
- Installation or replacement of seal may be difficult.
- Special tools and trained personnel required to install or replace seal for maintenance purposes.
- No direct access to clamping device or retainer and seal.
- Difficult to replace bolted clamping device or damaged retainer.

Application

Type C joints as per DSM 9.40.27 should be considered for all bridges but excluding the following:

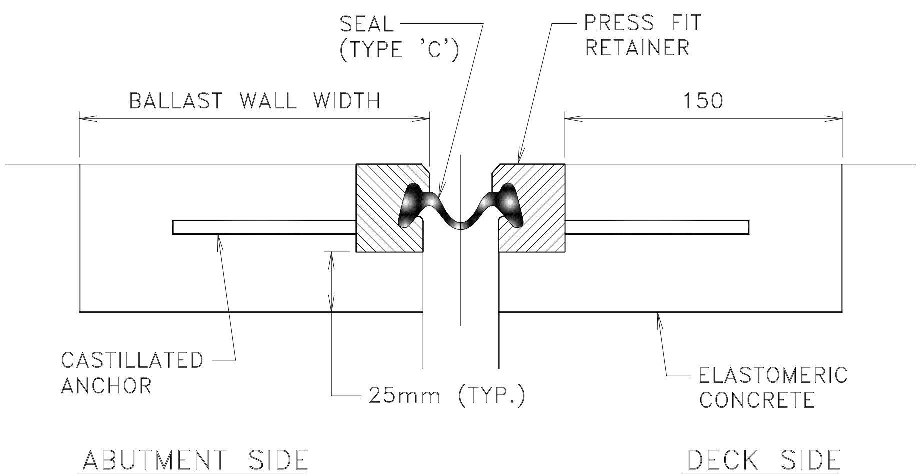
a. Bridges which carry high volume freeway/arterial traffic.

b. Bridges for which, in the opinion of the Head, Regional Structural Section, it is absolutely essential to minimise the frequency and duration of future in-service lane closures.

13.2.6 STRIP SEAL JOINTS ANCHORED IN ELASTOMERIC CONCRETE

The joints in this list are for replacement or modification of existing joints where no satisfactory anchorage exists or can be provided to accommodate DSM 9.40.24 to 9.40.28 joint assemblies.

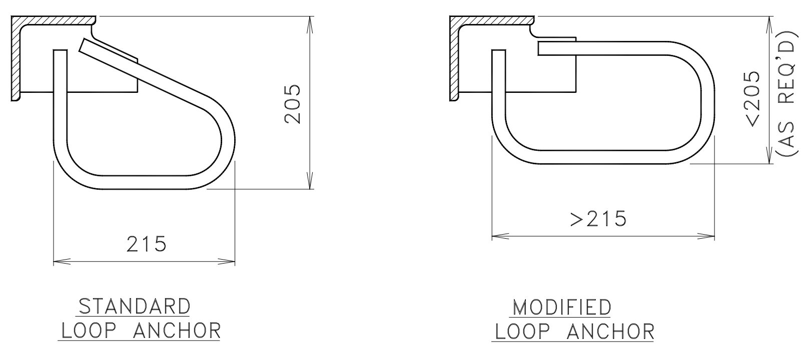
DSM 9.40.30 lists sources for Type A Steel Plate Clamping Device, and DSM 9.40.32 lists sources for Type C Retainers.



Elastomeric concrete has been used in (strip seal) expansion joint rehabilitation projects by MTO for the past several years, specifically on structures (mainly post-tensioned concrete) where the depth of blockout available is insufficient for the installation of expansion joints anchored in normal concrete. However, its use has exposed inherent disadvantages of joints anchored in elastomeric concrete, some of which are as follows:

- Inadequate durability evidenced in early development of cracks, substantial deterioration in less than 10 years, and the occasional separation of elastomeric concrete from the armouring.
- Approximately 50% higher material cost of elastomeric concrete, as compared to normal concrete, on a per linear metre basis of expansion joint blockout.

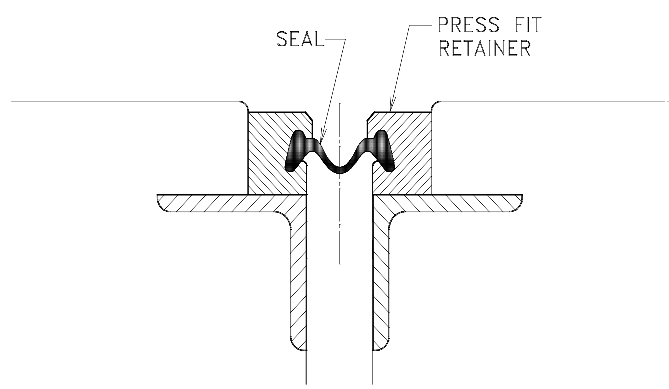
The designer should avoid the use of joints anchored in elastomeric concrete for joint replacement, whenever possible. Where expansion joint blockout depth is a problem (which is the case in most post-tensioned concrete decks), the anchorage assembly should be modified (by reducing the depth and correspondingly increasing the width of the loop anchors) as required, and anchored in normal concrete.



13.2.7 STRIP SEALS IN PREFORMED RETAINERS ON EXISTING ARMOURING

This list is for decks with concrete overlays where no other expansion joint assembly can be mounted on the existing armouring.

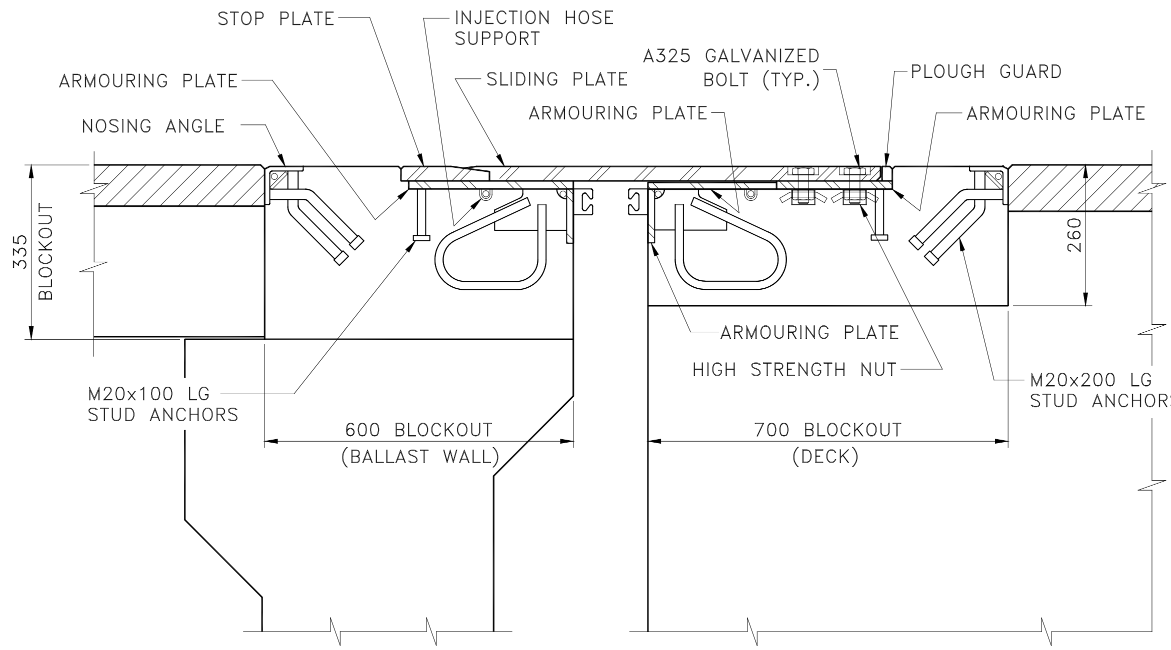
Where the existing anchorage has to be removed, the complete joint should be replaced by DSM 9.40.24 or 9.40.27 joint assemblies where appropriate.



13.2.8 SLIDING PLATE

Sliding plate expansion joints (see standards SS113-30 to SS113-35) shall be used for joints where the SLS design movement is greater than 75 mm and less than or equal to 120 mm.

Sliding plate expansion joints shall only be used at abutments of post-tensioned deck bridges and at abutments of girder type bridges. They shall not be used at pier locations.



13.3.1 ROTATIONAL BRIDGE BEARINGS - GENERAL

Sections 13.3.1 to 13.3.9 provide a summary of the features of rotational bearings which could affect bearing selection and identify the bearing design data for rotational bearings that must be shown on the plans. They do not apply to plain or laminated elastomeric bearings.

The Designated Sources For Materials List DSM 9.15.70 for Bridge Rotational Bearings (except elastomeric bearings) will include three types of bearings divided into six classes:

Class 1A. Pot Bearings Without Uplift Restraint Devices

Class 2A. Disc Bearings Without Uplift Restraint Devices

Class 3A. Spherical Bearings Without Uplift Restraint Devices

These bearings may be equipped with sliding surfaces for translation and guides for lateral restraint.

The need for uplift restraint devices is to be avoided and their use requires the approval of the Bridge Office Manager.

The selection of the bearings should be based on the articulation requirements of the structure. The requirements of the bearings such as translations, rotations, uplift, vertical and lateral load capacities and any special requirements must be established during the design process. It is expected that for a majority of bridges, any one of the three types of bearings will satisfy all the structural requirements. However there will be some bridges where, for special reasons, only one or two classes of bearings will be acceptable.

Expansion columns having bearings made of lubricated, unfilled TFE surfaces shall be proportioned based on a design coefficient of friction as given in Table 11.4 of the CHBDC.

13.3.2 EFFECT OF ROTATION ON ECCENTRICITY OF AXIAL LOAD

When a bearing rotates about a horizontal axis there is a shift in the axial load from the centre of bearing and the load becomes eccentric. The shift in the axial load depends on the type of bearing.

For pot and disc bearings, the shift in the axial load from the centre of bearing depends on the properties of the elastomer and is difficult to calculate. Creep of elastomer has a beneficial effect in reducing the shift for disc bearings. Tests indicate that the shift can be 2% to 4% of the diameter of confined elastomer for pot bearings, and 2% to as much as 30% of the diameter of elastomer disc for disc bearings.

For spherical bearings, the shift "e", in the axial load, depends on the coefficient of friction m, and the spherical radius of curvature, "R", and is expressed by:

$$e = \mathrm{m}R$$

Given the values of coefficient of friction specified in the CHBDC, and that the spherical radius of curvature "R" is generally between 1.0 and 2.8 times the plan diameter of the TFE curved surface, the shift in the axial load for spherical bearings can be 3% to 17% of the diameter of the TFE curved surface. At Serviceability Limit State Combination 1 loads and maximum rotation, OPSS 1203 limits the shift in the axial load from the centre of the bearing to the following values:

(a) 3% of the diameter of the confined elastomer for pot bearings;

(b) 10% of the diameter of the polyether urethane polymer compound for disc bearings;

(c) 10% of the plan diameter of the curved TFE surface for spherical bearings.

The effects of the maximum permitted shift in the axial load must be considered in the design of the affected structural components. Where it is difficult or costly to provide for the 10% shift, the choice may be restricted to pot bearings.

13.3.3 ROTATION CAPACITY

Rotational requirement about any horizontal axis and about the vertical axis through the centre of the bearing in the bearing design data table shall be as required by design.

13.3.4 TRANSLATIONAL CAPACITY

Rotational bearings shall have a translational capacity as stated below:

In unrestrained longitudinal direction - Maximum as required but not less than $\pm$ 50 mm.

In unrestrained transverse direction - Maximum as required but not less than $\pm$ 10 mm.

13.3.5 ORIENTATION OF GUIDED BEARINGS ON CURVED STRUCTURES

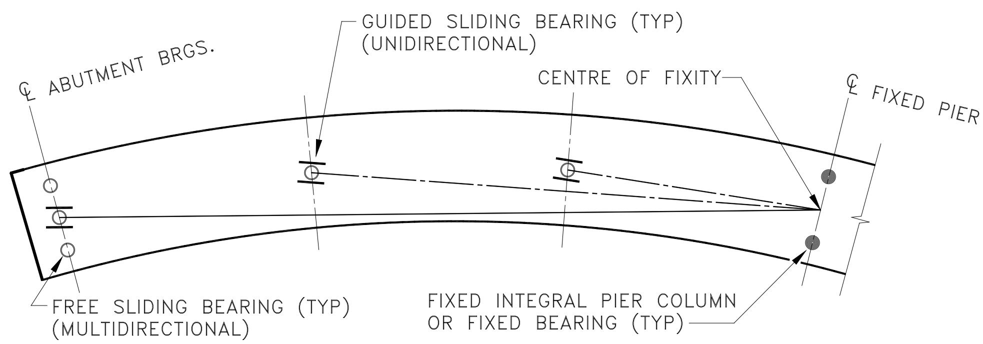
The designer should minimise the number of guided sliding bearings at each support (abutment or pier) location. One is usually adequate, and this should preferably be at the centre of the support. If multiple guided bearings are required at a support, the alignment should be the same for both and set to correspond to a point equidistant from each bearing.

Each support should have a minimum of 3 bearings, which would allow the centre bearing to be guided. If more are required for very wide and/or long-span bridges, odd-number of bearings should be used, again to allow for the centre one (only) to be guided.

In horizontally curved structures, two concepts generally exist when designing for horizontal movements. They are as follows:

(a) The structure is guided to a Centre of Fixity by aligning guided sliding bearings parallel to the chord drawn from the bearing to the theoretical point of fixity (see Figure 13.3.5(a)). The Centre of Fixity is the point of zero movement of the superstructure for internally induced forces or movements due to temperature change, as well as creep and shrinkage if applicable. It is calculated by taking into consideration the combined stiffness of all supports including shear stiffness of bearings, flexural stiffness of supports (abutment or pier) and rotation of footings due to strain of piles or subsoil.

    Bearing orientation A tends to accommodate the direction of the superstructure movements without introducing horizontal forces to the substructure due to these movements. However, for sharp or compound curves, this can introduce distortion at the abutment expansion joint for which it was not designed. One way to avoid this is to place the expansion joint perpendicular to the centroidal chord, but this is not recommended since it will necessitate skewed abutments.

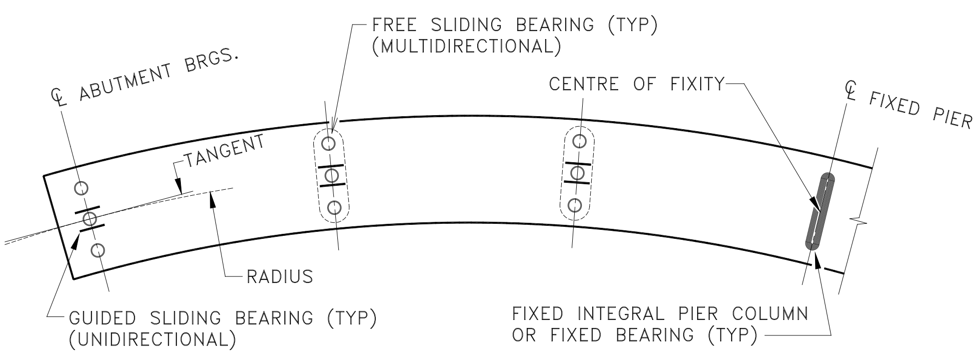


- Guided bearings aligned parallel to chord

FIGURE 13.3.5(a) BEARING ORIENTATION A

(b) The structure is guided tangentially by aligning guided sliding bearings tangent to the radius of the structure at the support (abutment or pier) location (see Figure 13.3.5(b)).

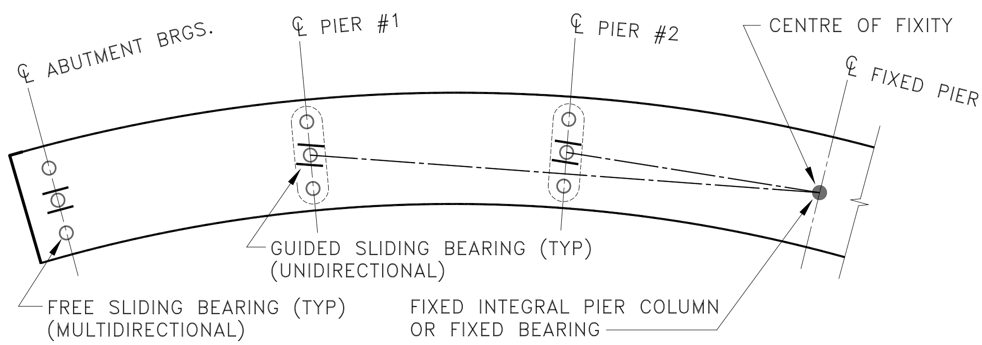
Bearing orientation B relies on the guided bearings to force the horizontal movement in the direction of the longitudinal curved axis of the superstructure, resulting in horizontal forces being transferred to the substructure through these bearings.



- Guided bearings aligned tangent to structure radius

FIGURE 13.3.5(b) BEARING ORIENTATION B

Both methods of bearing orientation have been used successfully in the past, each with their attendant benefits and disadvantages. The choice of method to use is left to the individual designer. However, since it is always better to minimise the introduction of additional forces or deformations into a structural system, the guided bearings at piers are recommended to be aligned as per Method A, while the guided bearings at abutments are recommended to be aligned as per Method B (see Figure 13.3.5(c)). As a result, because expansion joints at abutments are placed radially, they will expand and contract parallel to the abutment guided bearings without distortion.



- At Abutments, guided bearings are aligned tangent to structure radius
- At Piers, guided bearings are aligned parallel to chord

FIGURE 13.3.5(c)

Whichever method of bearing orientation is used in design, the designer is encouraged to use a refined method of analysis to determine the resulting horizontal movements and corresponding forces transferred to the substructure.

13.3.6 LATERAL LOAD CAPACITY

(a) Rotational Elements

Lateral Loads as specified on plans in combination with the applicable vertical loads.

(b) Translational Elements with Lateral Restraints and Anchors

For bearings with a capacity of 5000 kN or less	Maximum as required but not less than 10% of factored vertical load
For bearings with a capacity over 5000 kN	Maximum as required but not less than 500 kN plus 5% of factored vertical load in excess of 5000 kN

When more than one bearing with guides for lateral restraint are provided at a pier or abutment, only one bearing shall be considered to resist the transverse loads.

13.3.7 CONCRETE BEARING PRESSURE

The average concrete bearing pressure used by the bearing manufacturer to proportion the bearing shall be based on a concrete strength of 30 MPa.

The concrete bearing surfaces above and below the bearing should be proportioned and reinforced when necessary to withstand these pressures and lateral loads.

13.3.8 INSTALLATION

As the elevation at the top of bearings is critical especially for bolting diaphragms of steel box girders, the tolerances for the elevation at the top of bearings as specified in OPSS 1203 are as follows:

Concrete deck or girders	2.5 mm
Steel plate girders	1.5 mm
Steel box girders	1.0 mm

The Specification requires all bearings to be bedded over their entire area on an approved grout to achieve the theoretical elevations within these tolerances. The thickness of the bedding grout shall not be less than 5 mm nor more than 15 mm.

The height of bearing assumed in establishing the bearing seat elevation should include 10 mm for grout bedding and the drawings should include the following note:

> "Heights of bearings including 10 mm bedding grout assumed in establishing bearing seat elevations are as follows. The contractor shall adjust bearing seat elevations and reinforcing steel to suit actual heights of bearings.
>
> Abutments .... mm
> Piers .... mm "

Precautions must be taken by the Designer, when there is the possibility of bearings being installed under extreme cold or hot temperatures and not at 15°C. Either the top plate of a sliding bearing should be made sufficiently large to accommodate all of the maximum expansion and contraction movements, or alternatively the Designer should specify a temperature vs. setting table and corresponding details on the contract drawings.

13.3.9 BEARING DESIGN DATA

The Minimum bearing design data provided on the plans shall be as indicated below. Any special requirements must also be specified.

ROTATIONAL BEARING DESIGN DATA

LOCATION	TYPE	LIMIT STATE	COMBINATION	AXIAL LOAD	MAX. VERTICAL LOAD		MAX. ROTATION		MAX. TRANSLATION	
					LONGIT	TRANS	ABOUT HOR. AXIS	ABOUT VERT. AXIS	LONGIT	TRANS
			PERMANENT							
			PERMANENT + TRANSITORY MAX.							
			PERMANENT + TRANSITORY MIN.							
			PERMANENT							
			PERMANENT + TRANSITORY MAX.							
			PERMANENT + TRANSITORY MIN.							
			PERMANENT + EXCEPTIONAL MAX.							
			PERMANENT + EXCEPTIONAL MIN.							

Applied horizontal loads shall be consistent with applied axial loads

The contract drawings shall include the following notes:

1. ROTATIONAL BEARINGS SHALL BE CLASS/CLASSES LISTED IN DSM 9.15.71, 9.15.75, and 9.15.80 UNDER THE HEADING "BEARINGS, BRIDGE (ROTATIONAL)”.
2. THE CONTRACTOR SHALL ESTABLISH THE BEARING SIZE SUCH THAT CONTACT PRESSURE UNDER PERMANENT LOADS AT SLS IS NOT LESS THAN 25 MPA.
3. BEARING SUPPLIERS ARE REQUIRED TO PROVIDE ADDITIONAL ROTATIONAL CAPACITY OF 1.2 DEGREE ABOUT THE HORIZONTAL AXIS AND 1 DEGREE ABOUT THE VERTICAL AXIS IN ACCORDANCE WITH OPSS 1203 AND AS REQUIRED BY CHBDC.

The additional rotations mentioned in note 3 shall not be included in the bearing design table.

For bearings subject to uplift, the maximum permitted separation of the bearing components must be specified.

The maximum required translation (") must be based on the assumption that, at the time of installation, the longitudinal and transverse centrelines of the bearing sliding plate will be set to coincide with the longitudinal and transverse centrelines of the bearing.

The coefficient of friction for PTFE sliding surfaces given in the CHBDC depends on whether the PTFE resin is “filled” or “unfilled”. The type of PTFE resin assumed for design must be included with the bearing design data given on the contract drawings, specifically giving the following note: “UNFILLED PTFE, LUBRICATED DIMPLED SHEET HAS BEEN USED IN THE DESIGN FOR ESTABLISHING THE BEARING COEFFICIENT OF FRICTION.” This produces the minimum coefficient of friction. If for some reason the designer wants to transfer a greater than minimum horizontal force to a particular sub-structure, other sliding surface treatments given in the CHBDC may be considered.

13.3.10 PROVISION FOR FUTURE BEARING REPLACEMENT

Enough space, both vertically and horizontally, must be provided between the superstructure and substructure to accommodate the required jacks for replacing the bearings. While it is difficult to establish a vertical clearance for all situations, a minimum vertical clearance of 150 mm is suggested. For steel girder bridges the web stiffeners of the diaphragms must be located accordingly.

Connections, e.g. between bearings and shoe plates, must be bolted or make use of accessible screws and should only be welded when future access and removability can be guaranteed.

13.4.1 ELASTOMERIC BEARINGS

When choosing a bearing, the designer should give priority to specifying an elastomeric bearing because of its long term durability and cost effectiveness.

Elastomeric bearings, plain and laminated, shall be supplied in accordance with OPSS 1202. The following bearing sizes are recommended but other sizes may be available.

Size (mm x mm)	*Max. SLS Load (kN)	*Max. ULS Load (kN)
300 x 200	420	600
350 x 250	610	875
400 x 300	840	1200
450 x 350	1100	1575
500 x 400	1400	2000
550 x 450	1730	2475
600 x 500	2100	3000
600 x 600	2520	3600
600 x 700	2940	4200
600 x 800	3360	4800

Note: Max values obtained from 7.0 MPa and 10.0 MPa limits in CHBDC

Higher aspect ratio bearings may be preferable when thinner bearings are required and rotation limitations are governing, and may be used with approval

To ensure stability, the bearing plan dimensions (length and width) must be 5 or 3 times the effective elastomer thickness for plain and laminated bearing respectively, as per the CHBDC.

The rotational capacity of any bearing is a function of the effective elastomer thickness and is determined as per CHBDC so that the edge vertical deflection under SLS rotation and vertical load does not exceed 14% of the elastomer thickness.

The material for elastomeric bearings shall be shown on the drawings and should be based on where this structure is located as specified below:

South of and including latitude 45°:	Natural Rubber or Neoprene
North of latitude 45°:	Natural Rubber

13.4.2 ELASTOMERIC BEARINGS MINIMUM THICKNESS

Although the CHBDC permits the use of plain elastomeric bearings with thicknesses between 10 mm and 30 mm, the Bearings Committee feels that 10 mm is too thin and 30 mm is too thick. The thickness specified on the contract drawings should be between 15 mm and 25 mm. The shape factor must always be checked.

Plain elastomeric pads should be used when the thickness is 25 mm or less. Laminated elastomeric bearings with thicknesses of 25 mm or less have difficulty in meeting the Ministry's compression deflection requirements, therefore the minimum thickness for laminated elastomeric bearings shall be 40 mm.

13.4.3 STRIP BEARINGS FOR BOX AND HOLLOW SLAB GIRDERS

Strip plain elastomeric bearings may be used for precast box or hollow slab girder bridges. Thickness of the strip bearing shall not exceed 25 mm and only the durometer hardness needs to be considered.

13.4.4 LAMINATED ELASTOMERIC BEARING WITH SLIDER PLATE ASSEMBLY

This type of bearing might be the most cost effective choice for a long and relatively lighter structure. For durability reasons, a slider plate should not be used when a thicker bearing without a slider plate would be adequate.

13.4.5 SUPPLY OF ADDITIONAL SAMPLE BEARINGS FOR TESTING

To ensure the quality of the bearings supplied, standard special provision 922F01 requires that additional bearings be supplied by the contractor for testing purposes.

The number of bearings requiring testing is based on the type of bearing, and the number of bearings of each size. The fill-in special provision for bearings provides guidance to the designer on the exact number of bearings to test. This special provision shall be included in the contract. Note that each structure requires at least one bearing for testing if the bearings are of the plain or laminated elastomeric type. No samples for testing are required for bearings that are temporary and/or subsequently encased in concrete (e.g. bearings located at the integral supports of integral abutment type structures).

At the present time no additional bearings are required to be supplied for all other approved bearings (i.e. disc, pot, spherical).

Twin structures shall be considered as separate structures.

13.4.6 SHEAR RATE OF ELASTOMERIC BEARINGS

When an elastomeric bearing undergoes shear deformation due to horizontal loading, a horizontal force develops which is transferred to the substructure. The magnitude of this force is a function of the shear stiffness (shear rate) of the bearing at the time of displacement and the amount of bearing deformation.

The amount of deformation (due to superstructure movement) depends on the combined effects of the following internally induced forces:

(a) heat of hydration (of concrete)
(b) elastic shortening (of concrete due to prestressing)
(c) shrinkage (of concrete)
(d) creep (of concrete under prestress and permanent loads)
(e) temperature change (produces expansion / contraction)

Note: - (a) to (d) are applicable to concrete structures only
- (e) is applicable to all structures

The shear stiffness of any elastomeric bearing depends partly on the hardness of the elastomer (constant) but mainly on the ambient temperature. The shear stiffness is fairly constant for all temperatures above freezing, but increases rapidly with decreasing temperatures. At -40^{o}C, the shear rate can be two and a half times the stiffness at construction temperature.

In light of this, and since the various structure movements occur not only at its different ages (important when considering creep and shrinkage) but also at a variety of temperatures, the designer must use the bearing shear stiffnesses that correspond to each condition.

For bearing design data given on the contract drawings, the designer should give the shear rate that is neither K_{min} nor K_{max}, but the stiffness that corresponds to a maximum allowable shear rate at 20°C and 55 durometer hardness.

Bearing catalogues now provide the minimum (at 20^{o}C) and maximum (at -40^{o}C) shear rates for all laminated elastomeric bearings available. Combining the appropriate shear rates, as indicated in the following paragraphs, with the various horizontal movements will result in a combined effective shear force which neither underestimates nor overestimates bearing behaviour. This then produces the force that is transferred to the substructure for which it must be designed.

For temperature drop, even though the bearing will experience a sustained shear deformation over an extended period of time during cold temperatures, K_{max} should not be used. Rather, since in responding to temperature drop, the bearing stiffness starts at near K_{min} and increases to K_{max} at the lowest temperature, the arithmetic mean of the full range of K values should be used. Therefore, for temperature drop, $K=1.35x(K_{min})$ for natural rubber elastomers, and $K=1.60x(K_{min})$ for neoprene elastomers should be used.

For temperature rise, since such bridge movements occur at a temperature above 15^oC, $K=K_{min}$ should be used.

(A) Post-tensioned concrete structures

The superstructure may be jacked up (typically at approximately three months after construction) to relieve all horizontal shear deformation that has taken place in the bearing pad until that time, returning the bearing to its originally undeformed configuration. This puts the bearing movement due to heat of hydration, elastic shortening and a substantial proportion of the total shrinkage and creep into the first three months. After jacking, the bearing returns to vertical at the assumed construction temperature and must be designed for the remaining portion of shrinkage and creep, and all of the temperature change.

Because shrinkage and creep occur throughout the year, it is reasonable to use the average of K_{min} and K_{max} for those displacements, where K_{min} is the bearing shear rate at 20^oC and K_{max} is the shear rate at -40^oC.

For post-tensioned concrete structures which are not jacked up after three months to relieve bearing deformations, all five internally induced forces produce horizontal deformation of bearings. The magnitude of this total force depends on the appropriate shear stiffness of bearing being used for each of the horizontal movements of bridge superstructure. The following are recommended:

(a)	heat of hydration:	$K=K_{min}$
(b)	elastic shortening:	$K=K_{min}$
(c)	shrinkage:	$K=0.5x(K_{min}+K_{max})$
(d)	creep:	$K=0.5x(K_{min}+K_{max})$
(e)	temperature drop:	$K=1.35x(K_{min})$, [rubber];
		$K=1.60x(K_{min})$, [neoprene]
	temperature rise:	$K=K_{min}$

(B) Structural steel superstructures

Only temperature change is a relevant internally induced force that causes shear deformation of bearings. The following is recommended:

for temperature drop: $K=1.35x(K_{min})$, [rubber];
$K=1.60x(K_{min})$, [neoprene]
for temperature rise: $K=K_{min}$

(C) Precast prestressed concrete bridges

Heat of hydration and elastic shortening occur during fabrication, hence they do not affect bearing behaviour. We can assume that shrinkage (including differential) and creep-induced bridge movements will transfer horizontal forces to the substructure of a magnitude based on the average of K_{min} and K_{max}.

As with the other types of structures, bearing response to temperature rise should be based on K_{min}. For temperature drop, K=1.35x (K_{min}) [for rubber] and K=1.60x (K_{min}) [for neoprene] are recommended.

13.4.7 ELASTOMERIC BEARING DESIGN DATA

For elastomeric bearings, the minimum design data provided on the contract drawings shall be as indicated below. Any special requirements must also be specified.

ELASTOMERIC BEARING DATA

LOCATION		ABUTMENTS	PIERS
TYPE		---	---
SIZE (mm)		__x__x__	__x__x__
NUMBER REQUIRED		---	---
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	---	---
	TOTAL LOAD (kN)	---	---
	MOVEMENT (mm)	± ___	± ___
	ROTATION (radian)	---	---
	MAX. SHEAR RATE (kN/mm)	---	---
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	---	---
	TOTAL LOAD (kN)	---	---

The rotational capacity of any bearing specified or supplied shall be not less than ± 0.5 degree, and the edge vertical deflection under maximum rotation and vertical load shall not exceed 14% of the elastomer thickness.

Rotation in the bearing data table corresponds to total load.

13.4.8 INSTALLATION OF ELASTOMERIC BEARINGS

Elastomeric bearings are to be installed directly on the bearing seats. No filler or grout is to be shown on the drawings.

Precautions must be taken by the designer when there is the possibility of bearings being installed under extreme cold or hot temperature, and not at 15°C. The translational capacity of the elastomeric bearing shall be greater than the anticipated maximum movement.

For post-tensioned concrete structures, the use of a thicker elastomeric bearing may be a more economical choice than jacking the structure several months after stressing to release the shear deformation in the bearing.

Thicker bearings do not add significant costs and a taller bearing that reduces the force transferred to the substructure may be preferable in other situations as well.

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14 CULVERTS

14.1.1 CULVERTS - GENERAL

Preparation of contract documents for culverts, both concrete and corrugated metal, is to be carried out by the Regional Offices.

In cases where standard structures cannot be utilised, the Regions may request the Bridge Office to carry out all or part of the design work.

14.1.2 CONCRETE CULVERTS, CAST-IN-PLACE

All cast-in-place concrete culverts should be designed and detailed in accordance with the latest version of the "Concrete Culvert Design and Detailing Manual". In this manual the designs meet the requirements of CHBDC and the “Exceptions” in Division 1 of the Structural Manual and contains information necessary to complete the standard drawings and quantities for concrete box and open footing culverts. The following culvert types are covered:

a) Rigid frame open footing culverts with fill heights of 0.6 m to 6.0 m and sizes 2.0 m span x 1.25 m height to 6.0 m span x 4.0 m height.

b) Rigid frame box culverts with fill heights of 0.6 m to 6.0 m and sizes 2.0 m span x 1.25 m height to 6.0 m span x 4.0 m height.

c) Non-rigid frame box culverts with fill heights of 0.6 m to 5.0 m and sizes 1.25 m span x 1.25 m height to 1.5 m span x 1.5 m height.

Reduced scale copies of the standard drawings for all of the above culvert types are available in the “Concrete Culvert Design and Detailing Manual.”

14.1.3 CONCRETE CULVERTS, PRECAST

Precast concrete box culverts with spans greater than 3 m shall meet the requirements of the CHBDC.

Design specifications for precast culverts with spans up to and including 3 m are given in OPSS 1821 “ Material Specifications for Precast Reinforced Box Culverts and Box Sewers.”

14.1.4 REINFORCING STEEL BARS IN CULVERTS

Black steel reinforcement shall be used.

14.1.5 WATERPROOFING OF CULVERTS

Waterproofing and protection board shall be applied to the top surface of the top slab of all structural concrete culverts with fill heights less than or equal to 1000 mm. The waterproofing and protection board shall be continuous down the vertical exterior wall faces to a depth of 300 mm from the top surface of the top slab. In the longitudinal direction of the culvert, the waterproofing shall extend 1000 mm beyond the extent of the granular fill.

14.1.6 EARTH PRESSURE

Culverts and other structures where the deflection of the side walls is prevented by the propping action of slabs shall be designed for the at-rest earth pressure.

14.1.7 DESIGN OF CONCRETE CULVERTS

Beneficial effects of axial compression in flexural reinforced concrete culvert components shall be taken into account in proportioning the reinforcement whenever it is practical to do so.

14.2.1 CORRUGATED STEEL PIPE PRODUCTS - DIMENSIONING

Except for lengths, all dimensions of corrugated steel pipe products must be given in metric units, for both metric and imperial contracts.

14.2.2 LENGTH OF STRUCTURAL PLATE PIPES AND PIPE ARCHES

The overall length of structural plate pipe and pipe arches shall always be detailed on the drawings and the dimension shown shall always be a multiple of 610 mm, + 100 mm.

e.g. 61,100 mm is acceptable

This permits the use of an integral number of standard plate sizes without cutting, and ensures that the hook bolts in the cut-off walls will be aligned with the standard circumferential holes in the plates.

The spacing of hook bolts, if these are required, should be a multiple of 244 mm, to match the spacing of standard holes in the plates.

14.2.3 CORRUGATED METAL CULVERTS

All soil steel structures, 3.0 m and over, must be designed to the CHBDC. Site preparation must be such that there is an area on each side of the structure equal to half of the culvert span which will require engineered soils.

The use of pipe arches is restricted to sites at which round pipes cannot be accommodated. Other alternatives should also be considered.

It is necessary that the installation of pipe arches make provision for the necessary backfill volume of engineered soils (granular ‘A’) on each side of the structure and that each installation have cut-off walls or headwalls on each end.

Metal culverts under 3.0 m are not controlled by this procedure; but attention is drawn to the importance of site preparation and the use of properly compacted backfill material.

15 WOOD STRUCTURES

15.1.1 METRIC SIZES

Finished metric sizes for dressed wood are as follows:

Joist & Plank Lumber mm.	Rough Lumber mm.	Surfaced Timber mm.
38	51	-
64	76	-
89	102	-
114	127	114
140	152	140
165	178	165
184	203	191
-	229	216
235	254	241
-	279	-
286	305	292
337	356	343
387	406	394
-	457	445
-	508	495

The "Metric Handbook for Canadian Softwood Lumber" gives metric sizes for all available sections as shown above and for all other available lumber products.

15.2.1 PRESSURE PRESERVATIVE TREATMENT FOR WOOD

The Bridge Office policy with regard to the use of wood preservatives is as follows and shall be specified, as shown below, on the drawings.

Note:

Preservative Treatment of Wood

Treatment shall be in accordance with CSA Standard 080 Series-08 and AWPA Standards M1, M2 and M4. The type of wood preservatives shall be selected from the following:

(1) Creosote
(2) Pentachlorophenol in Type A hydrocarbon solvent
(3) Chromated Copper Arsenate (CCA)
(4) Ammoniacal Copper Arsenate (ACA)

The net retention of preservatives shall be the minimum specified in CSA 080 Series-08 for the applicable conditions and wood species.

Handling and storage of treated wood and treating of field exposed surfaces shall be according to CSA 080 Series-08.

Creosote and Pentachlorophenol shall not be used for the timber components with pedestrian contact. CCA is not acceptable for dimension structural lumber. The use of particular wood preservatives may be restricted because the regulatory status of wood preservatives is constantly reviewed by the Health Canada’s Pest Management Regulatory Agency for its application.

The standard construction note for handling of treated wood and treating of field-exposed surfaces is given in 2.5.7.

16 MISCELLANEOUS

16.1.1 APPROACH SLABS ON STRUCTURES

a. 6000 mm approach slabs shall be used on structures on all paved roads and on roads that are to be paved in the near future.

b. Provision shall be made for the future installation of 6000 mm approach slabs on all structures having concrete or steel decks.

c. Approach slabs are to have a wearing surface with no waterproofing. See 2.5.7 for note to appear on the plan on the general arrangement drawing.

d. If the approach slabs are not to be included in the bridge contract, the approach slab drawing should still be included in the contract drawings but must not bear the W.P. nor contract no. The general arrangement drawing must also carry the note:

"THE APPROACH SLABS ARE NOT PART OF THIS CONTRACT".

Stock-piled projects that carry a note having the same intent as the above but with different wording must be altered.

16.2.1 TRANSPORTATION AND FABRICATOR HANDLING OF STRUCTURAL COMPONENTS

Prefabricated, indivisible structural components that exceed (including the vehicle) any of the following limitations of

Length .... 19.0 m

Width .... 3.5 m

Height .... 2.6 m

Weight .... 30,000 kg

shall require special oversize/overweight hauling permit(s) in order to be transported by highway carrier over King's highways.

For the following two categories: (A) Routine oversize/overweight loads, and (B) Non routine oversize/overweight loads, pre-approval for King's highways transportation is not required. The length/width/height/weight limitations for both categories are detailed in S.P. No. 109F16, to which reference should be made.

Components exceeding the limitations of categories (A) or (B) require that the designer of the load obtain transportation approvals from the Weight and Load Engineer, Carrier safety and Enforcement Branch, MTO and other authorities, all as required by S.P. No. 109F16.

As early as possible in the design stage, written request for road-transportation shall be submitted to the Oversize / Overweight Permits Office for an in-principle special permit approval. The request shall indicate the number of components, dimensions, weights, travel origin and destination, duration of transportation and required travel frequency. The transportation approvals may take up to four (4) weeks and may not be granted if transportation is deemed to be unsafe.

16.3.1 SERVICES CARRIED THROUGH OR UNDER BRIDGES

Fluid carrying pipe lines are not normally allowed to be carried through or under bridges, unless approved. This includes oil and gas pipelines, sanitary and storm sewers and water mains.

Electrical power lines may be carried through, under, or over bridges provided the voltage does not exceed 44,000 volts.

The following details show approved details for the accommodation of non-MTO utilities on bridges. Bridges shall be used for this purpose only as a last resort and after the proponent has carried out a cost-benefit analysis. Schemes other than those shown below may be considered, subject to the approval of MTO.

Utility plant is not allowed in sidewalks or to be directly suspended from thin deck slabs. Also, utility hardware must not be placed in a location which prohibits routine inspection of structural components. In any case, it must not be located below the underside of girders for slab-on-girder bridges, or the underside of deck for slab-type bridges.

Steel components that make up the duct support system for bridges having an all concrete superstructure or for bridges having painted steel girders, must be stainless steel, galvanised, metallised or painted. For bridges having ACR steel girders, all non-embedded components may be fabricated of the same steel. Attachments shall not be welded to flanges of superstructure girders.

Where necessary, the designer must also provide special details to allow the utility ducts to pass through the abutment ballast walls and superstructure diaphragms. These details must ensure (i) that the ducts will be able to accommodate all prescribed structure movements including deck jacking for bearing repairs, (ii) that fill material from behind the ballast walls is not washed out, and (iii) any settlement that may occur in the fill material behind the ballast wall does not impose undue stresses on the ducts. When the utilities are run through a steel box girder, the designer must consider the location of intermediate cross-braces, vertical stiffeners in pier diaphragms, access openings in pier diaphragms, etc. All utilities shall be designed with provisions to allow for future bridge maintenance.

(a) <u>Duct Location For Structures With Accessible Cavities Or Spaces Located Within The Limits Of The Perimeter Of The Superstructure</u>

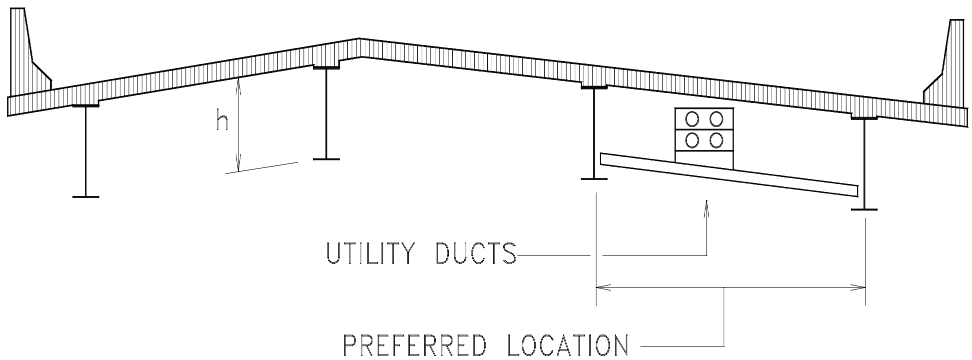


FIGURE 16.3.1(a) SLAB-ON-CONCRETE/STEEL I TYPE GIRDERS

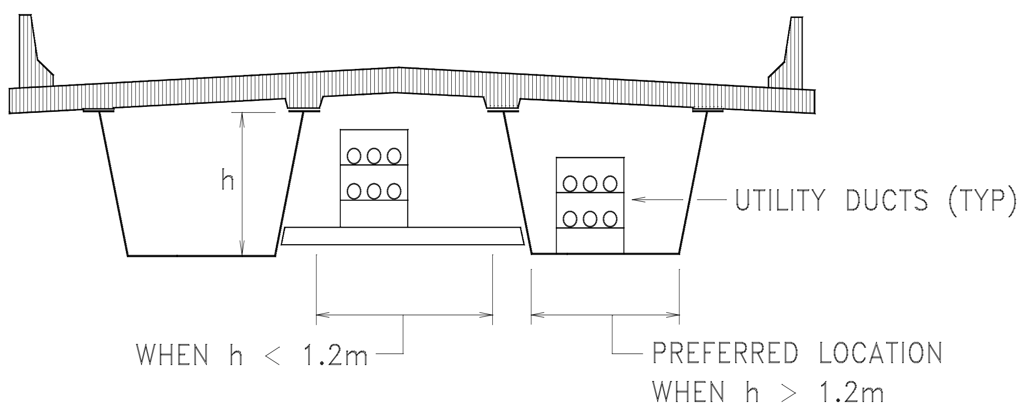


FIGURE 16.3.1(b) SLAB-ON-CONCRETE/STEEL BOX GIRDERS

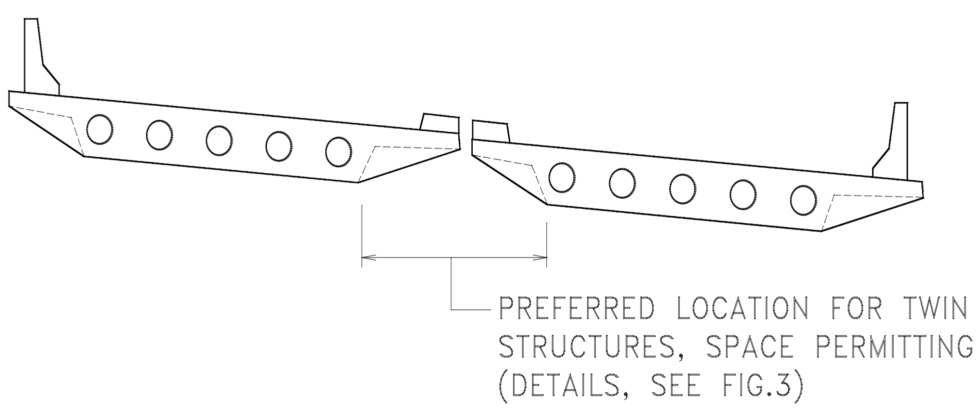


FIGURE 16.3.1(c) TWINNED ROUND-VOIDED POST-TENSIONED DECKS

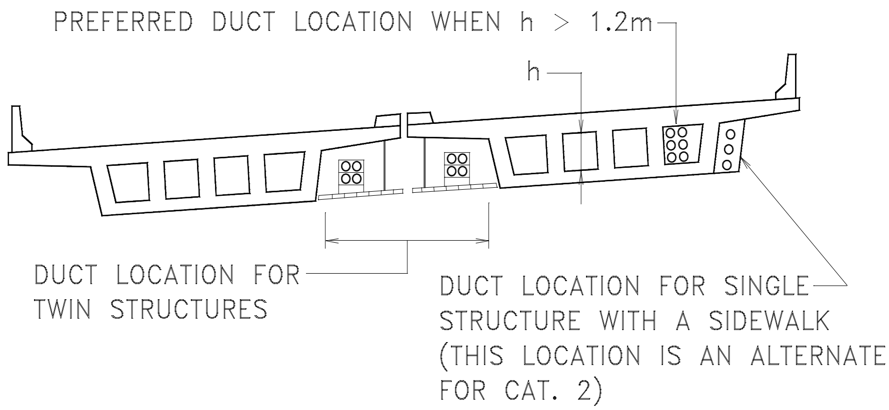
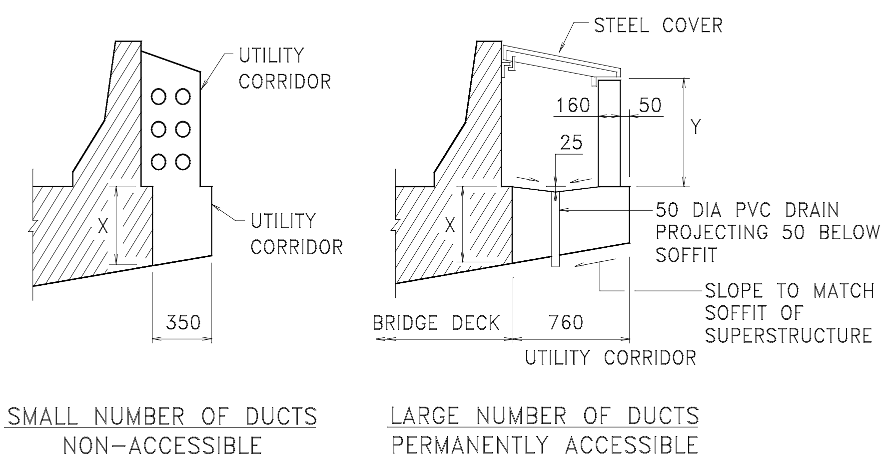


FIGURE 16.3.1(d) TRAPEZOIDAL BOX POST-TENSIONED DECKS

(b) <u>Duct Location In Slab Type Structures, Superstructures Without Accessible Cavities</u>

Projects covered by this criteria require the construction of a non-structural utility corridor outside of and adjacent to the barrier wall. Structure types included in this category include rigid frames, culverts, and solid or round-voided post-tensioned concrete structures. This scheme is best suited for structures without sidewalks or situated in non-urban locations because of the possibility of pedestrians climbing up onto the utility corridor.



Structure Type		Sidewalk	X (mm)	Y (mm)
Slab		with	500	625
		without	350	825
CIP, P/T deck	Tapered cantilever	with	600	625
		without	600	825
	Wing cantilever	with	600	625
		without	450	825

FIGURE 16.3.1 (e) CANTILEVERED UTILITY CORRIDOR

Electrical lighting ducts (including MTO utilities) shall not exceed 50 mm diameter, except when installed in barrier walls, and shall be placed in accordance with the following criteria:

1. In abutments, ballast walls, slab piers and rigid frames, members must be greater than 500 mm in thickness and spacing of adjacent ducts shall be not less than 6 m.

2. In round columns:

   - Maximum of one electrical duct, outside diameter not exceeding 50 mm, may be placed at centre of columns having a diameter of 1000 mm or more.

   - Junction boxes are not permitted in columns.

   - Entrance/exit of duct at the bottom of columns to be through the footing.

   - Entrance/exit of duct at the top of columns:

     - for fixed-fixed columns (no bearings at top) the duct shall pass straight through the deck-column interface.

     - for columns with bearings at top, duct may pass through side of column, provided it does not interfere with reinforcement or bearing assembly and is kept clear of the zone of high stress near the bearings.

3. In post-tensioned decks:

   - Ducts and junction boxes may be placed in post-tensioned decks provided they are located in solid portions of the deck adjacent to supports; they must be placed above the bottom mat of reinforcement (and transverse post-tensioning, when present).

   - Longitudinal ducts placed in post-tensioned decks may be located inside deck voids, but in any case shall not be located in web portions of the deck.

When ducts are to be placed in such elements, positive drainage of the embedded duct work must be assured and the ducts must be located behind the steel reinforcement. The structural Engineer shall also give consideration to the location of junction boxes necessary in such installations and to the potential effects of duct bursting on the structural integrity of the component(s). Electrical ducts left unused would need to be grouted as is required with unused post-tensioning ducts.

Other services may be provided for only as a result of specific approvals and agreements. These, and approval for exemption from above restrictions, should be referred to the Assistant Deputy Minister of Operations.

16.3.2 ELECTRICAL GROUNDING OF STRUCTURES

Railings attached to a structure must be electrically grounded if the structure carries electrical power conductors or provision for them. The Electrical Engineering Section details the grounding.

Bridges having lighting ducts require grounding but those carrying only telephone ducts or cables do not.

High level bridges may require lightning protection. Such structures should be referred to the Traffic Management and Engineering Office, Electrical Engineering Section.

16.4.1 TEMPORARY MODULAR BRIDGES

The use of temporary modular (TM) bridges (brand names: Acrow, Bailey, etc.,) is primarily for installations generated from emergencies in the Ministry or municipalities, or for seasonal use as detours at Ministry construction sites. The use of TM bridges for permanent structures is discouraged.

The responsibility and control of the supply, maintenance and inventory of all TM bridge components under the jurisdiction and ownership of MTO is governed by the following Policy, Planning & Standards Directive PLNG-B-007 (formerly Quality and Standards Directive QST-B-20 *"Temporary Modular Bridges"*), revised August 2000:

"Temporary Modular Bridges": (A) Issuing Priorities
(B) Supply, Maintenance and Inventory Control
(C) *Retrieval, Rental and Disposal* "

A summary of the contents of this document is given in this subsection.

Municipality Needs

The Ministry will only supply TM bridges to municipalities when there is a real emergency. The Ministry will not supply TM bridges to municipalities for detour purposes when new bridges are being constructed or for bridge rehabilitations.

Municipalities that need TM bridge components in an emergency shall initially attempt to obtain their requirements from the private sector. If the private sector is unable to supply the components within one week from the date of the emergency, the municipality may request them from the Ministry. When submitting a request to the Ministry, the municipality must provide evidence that they were unable to obtain the TM components in a timely manner. The procedure to follow when making an emergency request and details of a legal TM bridge rental/purchase agreement that has to be entered into is given in Directive PLNG –B-007.

Other Agencies

The Ministry will not supply TM bridges to any other jurisdictions.

Issuing Priorities

The Regional Director for the region in which the TM bridge is required is responsible for approving the release of TM bridges. The Manager of Operations, Northern Region, North Bay is responsible for issuing TM bridges. Issuing priorities will be in the following order of precedence:

1. Emergency needs on the Ministry's Provincial Highway System
2. Emergency needs in municipalities
3. Detour needs on the Ministry's Provincial Highway System

Emergency Needs

To ensure a responsible supply of TM bridge components sufficient to meet most anticipated emergencies, the Ministry maintains and services an emergency stock of TM components at a stockyard in Northern Region.

An emergency may exist due to failure of any bridge component or collapse of an existing bridge that leads to a permanent closure of the bridge. An emergency requiring the issue of TM bridge components is deemed to exist when one or more of the following conditions are satisfied:

(a) An existing structure has been damaged beyond immediate repair.

(b) The road is completely closed to traffic due to damage to the bridge.

(c) The shortest detour that exists exceeds what would normally be considered reasonable for purposes of emergency response (i.e. fire, police and ambulance.)

(d) The time required to make repairs to the existing structure is considered excessive.

(e) Alternative solutions, other than the supply of TM bridge components are not viable.

The approval procedure for emergency requests at Ministry and municipality sites, prior to the release of TM bridge components, shall be as detailed in Directive PLNG-B-007.

Detours and Non-Emergency Needs

At present, the Ministry maintains and services a portion of the existing inventory of TM bridge components for use as detours at Ministry construction sites. This stock is kept separate from that intended for emergency use. However, this detour stock may be depleted by attrition with time and the supply of TM components for operational needs will eventually be obtained from the private sector.

The need for a TM bridge and sufficient information for design must be clearly stated in a Structural Planning Report. This will be the Structural Planning Report for a structural project for which a TM detour is required or, if the TM bridge is not part of such a project, a separate report.

TM bridge drawings, quantities, and appropriate tender items are to be prepared by the Regional Structural Section responsible for the project. Site numbers should be assigned with the latter B added, e.g. 34-2221/B in the title block (see section 2.5.1.).

During the preliminary stages of design, the Regional Structural Section shall obtain confirmation from the Manager of Operations, Northern Region that the required quantities of TM bridge components will be available when needed. If this is not possible then consideration shall be given to alternative designs from the private sector.

The approval procedure, bills of materials and requests for the release of TM bridge components shall be as detailed in Directive PLNG-B-007.

16.4.2 POSTING LOAD LIMITS ON BAILEY BRIDGES

Bailey Bridges have been used in Ontario for over a half century. Due to their modular components, Bailey bridges can be assembled in numerous ways, with multiple truss panels either adjacent or on top of each other. Similarly, the floor system is made up of a number of adjacent stringer sets (depending on the width of bridge) and a number of transverse floor transoms, usually 2 or 4 per 10 ft (3 m) bay.

For Bailey Bridges with 2 floor transoms per bay, an evaluation according to the CHBDC found that the load carrying capacity of the floor system was deficient. Subsequent load testing by the MTO Bridge Office confirmed that the floor system was incapable of carrying full CHBDC CL-625-Ont loading.

Consequently, all new Bailey Bridge installations shall be specified with 4 transverse transoms per bay when load posting is not desirable and when 2 transverse transoms are specified, the bridge shall have a triple load posting of 25 tonnes, 40 tonnes, and 55 tonnes for a single, two unit and multi-vehicle train respectively.

16.5.1 NOISE BARRIER DESIGN

Noise barriers shall be designed in accordance with the CHBDC as light slender structures not unusually sensitive to wind action, and CSA-Z107.9, Standard for Certification of Noise Barriers. Wind loads and ice accretion loads on panels shall be as prescribed for sign panels. Reference wind pressures for a 25 year return period shall be used.

In the calculation of section properties and strength for cold formed steel members, for which the provisions of the CHBDC are not applicable, the requirements of CSA-S136 for ultimate limit state design shall apply.

In evaluating or designing a structure on which a noise barrier is to be mounted, the above criteria shall apply, except that the local reference wind pressure shall always be used and a gust factor of 2.0 is sufficient for the relatively rigid structures (e.g. retaining walls), to which noise barriers are generally attached.

16.5.2 GUIDELINES FOR NOISE BARRIER WALLS ON BRIDGES

Background

Noise barriers have been erected on Ministry highways and bridges since the late 1970's, and the most commonly installed system has been the product with the trade name “Durisol.” This system consists of proprietary panels made out of compressed wood chippings and cementitious materials. It is erected between steel posts and is the only approved noise barrier product currently on the Ministry’s DSM list. Corrugated steel panels between steel posts have also been installed in the past but at present are not being used by the Ministry. New products are now available such as polyethylene panels and transparent acrylic sheets which are being considered for approval.

The current practice for erecting noise barriers on the Ministry’s infrastructure is as follows:

1. When noise barriers are required on roadways and are located beyond the clear recovery zone, then the noise barriers are erected simply between steel posts.

2. When noise barriers are required on roadways and are located within the clear recovery zone, then the noise barriers are erected on top of or immediately behind New Jersey barrier walls.

3. On bridges and retaining walls, the noise barriers are usually within the clear recovery zone and are generally attached either on top of or to the back face of barrier walls. This method of installation has been used for many years and available accident data related to vehicle-barrier impacts, although the actual number of installations is too small to allow us to draw statistical conclusions, has not shown any detrimental effects.

The CHBDC requires the use of crash tested traffic barriers as per NCHRP Report 350 “Recommended Procedures for the Safety Performance Evaluation of Highway Features”. However, currently there are no crash tested noise barrier walls available that the Ministry can utilize to install within the clear recovery zone on bridges. Since the current method of installing noise barriers have not exhibited any detrimental effects on safety and at present there are no other better alternatives available, the Ministry as an interim measure, will continue to use the current approach with additional procedural and safety improvements including the prevention of debris from falling on to traffic or people below when a vehicle noise barrier accident occurs.

Recommendations

1. Before a noise barrier is considered for use on a bridge, a cost-benefit analysis should be carried out. This study should consider, but not be limited to, the following:

   - That the noise reduction is significant enough to warrant the use of a noise barrier.
   - That there are a reasonable number of residents that are expected to benefit from the reduction in noise level as determined by Ministry Directive A1.
   - Stopping the noise wall at the bridge and turning it obliquely (flanking) away from the highway towards the residential area. In effect avoiding noise barrier walls being erected on the bridge itself.
   - The effect of increased loading to the structure (from vertical, wind, torsion loads etc.). These effects may create the need for additional girders and cross bracing, and a refined structural analysis for verification.
   - Access for inspection of the bridge and the noise barrier components.
   - Cost of an approved traffic/noise barrier wall system and additional costs to the structure.
   - Possible snow accumulation.
   - Aesthetics

2. Where it has been assessed that it will be beneficial to install a noise barrier wall, the following procedure shall apply:

   a) Use the current installation method of connecting to structures or any other systems/methods developed by the Ministry and others as acceptable to be installed within the clear recovery zone.

   b) On bridges and retaining walls, or portions thereof, where debris falling below will endanger public safety provide containment designs to prevent pieces or whole panels and posts of noise barriers becoming detached and falling.

16.6.1 ROCK PROTECTION

In the OPS specifications, the material previously specified as "random rip-rap" is now "rock protection”.

The following will therefore apply:

a. All drawings presently being prepared for contracts should use the description "Rock Protection".

b. In the planning report a statement will have to be made as to whether broken rock can be used as rock protection or not.

Stockpiled projects should be updated to comply with the above.

16.6.2 SLOPES

The normal slope for permanent earth cuts and fill is 2:1. For appearance, to facilitate grass cutting or to dispose of surplus or unsuitable (e.g. organic) fill, slopes flatter than this are often used; but these reasons do not justify increasing the length of a bridge nor the height of an abutment.

Slopes steeper than 2:1 are not used under bridges without surface protection. Rock fill can be stable at a slope of 1.25:1 and slopes with rock protection can be stable at 1.5:1. Such intended slopes must be approved by the Foundations Section at the preliminary design stage.

16.6.3 SLOPE PAVING

All inclined earth surfaces bounded by the vertical projection of the deck onto the ground below shall be paved up to the face of the abutment.

16.7.1 HIGH MAST LIGHTING POLES

The design of high mast lighting (HML) poles and their foundations shall be based on the requirements of the CHBDC. A reference wind pressure for a 50-year return period shall be used. AASHTO’s “Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals” shall also be used for design requirements, for example fatigue design, not specified by CHBDC. However, where there is a conflict the CHBDC shall govern.

On Ministry projects pole heights of 25, 30, 35, 40 and 45 m are currently used and the design for these high mast lighting supporting structures has already been carried out. MTO issued standard drawings showing details of these structures. General details are shown on the following MTO standards:

MTOD 2450.011 HMLP 25, 30 & 35 m 8-Sided Pole
MTOD 2450.021 HMLP 40 & 45m 12-Sided Pole

The installation of high mast poles is covered by OPSS 630 “Construction Specification for the Installation of High Mast Poles” and related special provisions.

High mast lighting supports have fixed based support systems that do not yield or break away upon impact. The large mass of the poles and the potential safety consequences of them falling to the ground necessitate a fixed base design. Since fixed base systems are rigid obstacles they should not be used in the roadside clear zone unless protected by a barrier.

16.7.2 HIGH MAST LIGHTING POLE FOUNDATIONS

An anchorage assembly detailed on the following standards connects the high mast lighting support to a concrete caisson foundation:

OPSD 2218.010 HML Pole Anchorage Assembly Placement
OPSD 2456.011 HML Pole Anchorage Assembly Details

The design of foundations shall be based on the requirements stated in the above clause 16.7.1.

Foundations for high mast poles may be designed according to the Bridge Office publication BRO-009, “Guidelines for the Design of High Mast Pole Foundations, third edition,” which is based on the requirements of clause 16.7.1 above. This guide presents the design of concrete caisson type foundations in a variety of soil conditions including rock and layered soils. The designs and design methods given in this document are modeled on short piles with a rotational limit of 0.005 radians at the ground surface, and the theoretical analyses given in papers by Bengt Broms and others.

The following standard drawings for high mast pole foundations that are ground or median mounted are available for use:

SS116-50 High Mast Lighting Pole Footing Ground Mounted
SS116-51 High Mast Lighting Pole Footing Median Tall Mounted (Symmetrical)
SS116-52 High Mast Lighting Pole Footing Median Tall Mounted (Asymmetrical)

The construction of foundations for high mast poles is covered by OPSS 631 “Construction Specification for Concrete Footings and Maintenance Platforms for High Mast Lighting Poles” and related special provisions.

16.8.1 DOWELS IN CONCRETE

Installation and acceptance testing and frequency shall be according to SP 999S29, September 2010.

When dowels in concrete 25M or larger, must be specified, the Concrete Section and the Bridge Office shall be consulted regarding the bonding system and/or testing frequency.

Subsequent to the collapse of the suspended ceiling system of the I-90 connector tunnel in Boston on July 10, 2006, the FHWA conducted an independent investigation and issued a Technical Advisory on October 17, 2007. The Technical Advisory strongly discourages the use of fast set epoxy for adhesive anchor applications. Furthermore, the use of any kind of adhesive anchors for permanent sustained tension applications or overhead applications is strongly discouraged until the FHWA is satisfied that an improved certification process has been developed to ensure satisfactory long-term creep performance and for overhead applications.

MTO Material Engineering and Research Office (MERO) maintain a DSM listing of adhesives for dowels, including both epoxy and acrylic-based products. A limited scope of tests were conducted on the available products in the late 1980's and the results were documented in Report MI-120 dated April 1988. Since that time, additional products have been accepted for the DSM based on test information submitted by the manufacturers verifying compliance with the acceptance criteria. However, the current acceptance criteria do not include assessment of creep characteristics of the adhesives under sustained load or performance of embedded dowels in freeze thaw conditions. Although the FHWA Technical Advisory does not address freeze thaw effects, Bridge Office believes freeze thaw effects could affect the long term performance of certain adhesives and should be investigated.

MERO is currently conducting a review of all the products in the DSM to identify products of the fast set type similar to those used at the Boston Tunnel; products that do not have creep or freeze-thaw tests records will also be identified. The DSM will be amended accordingly.

MERO is also seeking to initiate a university research project as part of the 2008 Highway Infrastructure Innovation Programme, as to develop more comprehensive criteria for the acceptance of adhesives for dowel applications in Ministry work. The intent of the improved criteria would be to provide greater assurance of long-term performance.

Until the completion of the product review and conclusion of the research project, the following interim guidelines are provided to ensure public safety and long term performance of the infrastructure:

<u>Recommendations</u>

1. Epoxy anchors/dowels shall not be used for applications where sustained tensile load exceeds 25% of the allowable tensile capacity of the dowel based on bond. The allowable bond capacity is usually the ultimate bond capacity divided by a factor of safety of 4.

2. For all applications other than anchorage of barrier/parapet walls and expansion joint end dams, epoxy anchors/dowels shall not be relied on to provide more than 25% of the total required tensile resistance at the critical section. In most situations, this will necessitate the removal of enough concrete so that new reinforcement could be lapped with existing reinforcement, otherwise, a suitable mechanical mean of anchorage shall be provided to develop the required tensile capacity beyond the critical section.

3. For anchorage of new barrier/parapet walls on existing deck and for

expansion joint end dams, a special provision will be developed to restrict the applications to only those products that we have confidence in their long term performance based on current information.

4. The use of fast set epoxy is prohibited for all applications.

16.9.1 PEDESTRIAN AND BICYCLE BRIDGES

This section provides guidelines for the design of pedestrian and bicycle bridges.

16.9.2 VERTICAL CLEARANCE

The minimum vertical clearance over the roadway for pedestrian and bicycle bridges shall be according to the Geometric Design Standards for Ontario Highways Policy. The current policy, in clause C.4.4.3.1, calls for a minimum vertical clearance of 5.3 metres.

16.9.3 PEDESTRIAN LIVE LOAD

The pedestrian live load applied to the walkway area shall be as specified in clause 3.8.9 of the CHBDC and shall be applied in such a way as to induce the maximum stresses in the member being designed.

16.9.4 MAINTENANCE VEHICLE LOAD

When the width of a pedestrian/bicycle bridge is greater than three (3.0) metres and access is provided for maintenance vehicles, the maintenance vehicle load specified in clause 3.8.11 of the CHBDC shall be considered on the walkway area. The maintenance vehicle load shall not be applied in combination with pedestrian live load.

Where the bridge is fully enclosed, maintenance vehicles shall be prevented from accessing the bridge by installing physical barriers (i.e. posts spaced in a way that will allow passage of bicycles and wheelchairs etc. but not maintenance vehicles) and the maintenance vehicle load need not be considered.

16.9.5 WIND LOAD

Wind load on pedestrian/bicycle bridges shall be as specified in clause 3.10 of the CHBDC and shall be applied in such a way as to induce the maximum stresses in the member being designed.

The wind load on live load specified in clause 3.10.2.4 seems unrealistic to apply to pedestrian loads and is also excessive to apply to the occasional maintenance vehicle and should be ignored.

16.9.6 OTHER LOADS

All other permanent, transitory and exceptional loads given in the CHBDC shall be considered if applicable. Other loads including possible snow accumulation according to the Ontario Building Code shall also be considered.

16.9.7 LOAD COMBINATIONS

The loading combinations to be considered and the load factors to be used shall be as specified in clause 3.5.1 of the CHBDC.

Engineering judgement shall be used when combining snow accumulation with other loads.

The following load combinations shall be checked as a minimum:

SLS1+1.0S
ULS2+0.5S
ULS3+0.5S

Plus one combination with full ULS factored dead loads plus 1.5S

Where:

S is the snow accumulation load according to the Ontario Building Code

16.9.8 DEFLECTION

Deflection limits are currently not specified in the CHBDC; however, the following deflection limits, taken from the AASHTO Guide for Design of Pedestrian Bridges and modified, shall be satisfied:

- Members shall be designed such that the maximum deflection, at the SLS, due to the pedestrian live load does not exceed 1/600 of the span.
- The deflection of cantilever arms, at the SLS, due to pedestrian live load shall not exceed 1/350 of the cantilever length.
- The horizontal deflection, due to lateral wind load and using a service load factor of 1.0, shall not exceed 1/600 of the length of the span.

16.9.9 VIBRATION

The requirements of clause C3.4.4 of the Commentary to the CHBDC, as they pertain to pedestrian bridges, shall be considered as mandatory provisions for the SLS. Sway vibration caused by pedestrian live load shall also be considered.

16.9.10 FATIGUE

The allowable fatigue stress range for steel members shall be determined from clause 10.17 of the CHBDC for wind load and pedestrian live load induced fatigue. At the fatigue limit state the associated factors shall be taken as 1.0 and the number of cycles to be considered shall be 200,000 recognizing that wind loads and pedestrian live loads near the maximum design level are infrequent.

16.9.11 MINIMUM THICKNESS

The minimum thickness *specified* for HSS shall be 6.4 mm.

16.9.12 WELDED CONNECTIONS

Welded connections shall be according to CHBDC and section 12 of W59.

16.9.13 TOP CHORD STABILITY

For truss bridges with open tops, the stability of the top chord in the lateral direction shall also be considered.

16.9.14 CONSTRUCTION STAGES

All construction stages, including methods of construction (i.e. lifting or sliding the completed structure in place) and the imposed temporary loads, shall be considered in the design.

16.9.15 AESTHETICS

Pedestrian/bicycle bridges require a medium or high level of aesthetic consideration and treatment, as they will generally be seen by a large number of people. Bridges with chain link fencing are usually considered unsightly and should not be considered for these cases. In special situations a signature type of pedestrian bridge may be required.

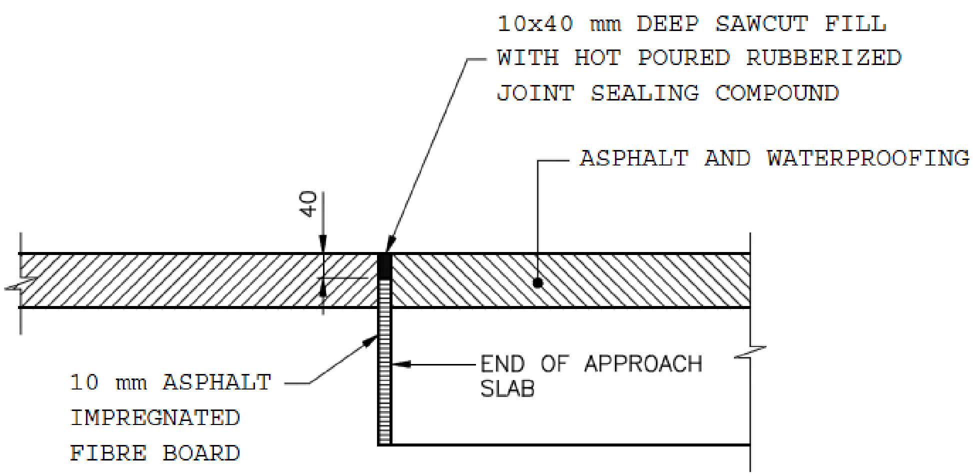
16.10.1 ACCOMMODATING MOVEMENTS AT THE END OF THE APPROACH SLAB OF INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES

Integral abutment bridges are single or multi-span bridges with the superstructure integrally connected to the abutments. Each abutment is supported on a single row of piles and moves together with the superstructure to accommodate expansion and contraction. The approach slab is also integrally connected to and moves together with the superstructure and the abutment.

The movement demand is directly proportional to the expansion length of the superstructure. Current trend is to make longer and longer bridges integral and semi-integral in order to eliminate the expansion joints. Consequently, we find that we have to accommodate larger and movements at the ends of the approach slabs. Presently, a bridge can be made integral when the expansion length of the superstructure does not exceed 75 m (i.e. total length of 150 m). The specified treatment at the end of the approach slab should vary with the expected movement.

Recommendations:

1. For integral and semi integral abutment bridges where the expected movement at the end of the approach slab does not exceed 10 mm, the requirements shall be as shown below:



2. For integral and semi integral abutment bridges where the expected movement at the end of the approach slab is between 10 and 40 mm, standard drawing SS113-37 shall be used.

3. For integral and semi integral abutment bridges where the expected movement at the end of the approach slab is greater than 40 mm, standard drawing SS113-36 shall be used.

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17 COMPUTER APPLICATIONS

17.1.1 LIST OF COMPUTER PROGRAMS

The programs supported currently by the Bridge Office are listed below:

PROGRAM	DESCRIPTION	MAINFRAME	PC
BR0013010 to BR0013014	Ontario Structure Clearance and Load restriction Information System (OSCLIS)	**A**	
OBMS	Ontario Bridge Management System: Restricted to MTO and consultants hired by MTO		**A**

Notes:

1. **A** currently available.
2. BR0013010 to BR0013014 (OSCLIS) are on the MTO mainframe computer.

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18 SIGN SUPPORTS

18.1.1 SIGN SUPPORT STRUCTURES

The design and detailing of standard sign support structures is to be carried out in accordance with the latest version of the Sign Support Manual (SSM).

The SSM contains information needed to prepare the contract drawings, tender quantities and special provisions for standard sign supports. The design of the cantilever, tri-chord, and variable message sign (VMS) sign supports meets the requirements of the CHBDC.

All non-standard sign supports must be custom designed.

The standard sign supports covered by the SSM are:

Overhead Sign Supports

a. Cantilever Static Sign Supports

A sign support which cantilevers from the roadside over the closest driving lane and shoulder for static signs. Two types of cantilevers sign support, Single cantilever and butterfly, are currently available in the SSM. This sign support is suitable for total signboard sizes up to and including 48 m^2, depending on the sign type, class, reference wind pressure and the eccentricity of the centreline of the signboard. The structure is constructed of galvanised structural steel and consists of an overhead truss supported on a single leg column with a concrete caisson type foundation.

b. Tri-Chord Static Sign Supports

Simply Supported Type:

A sign support that crosses the highway with spans ranging from 14 m to 36 m inclusive. This sign support is suitable for signboard sizes up to and including 45 m^2. The structure is constructed of galvanised structural steel and consists of a three-chord overhead truss supported on single leg columns with concrete caisson type foundations.

Cantilever Type:

A sign support which cantilevers from the roadside over the closest driving lane and shoulder. This sign support is suitable for total signboard sizes up to and including 26.7 m^2. The structure is constructed of galvanised structural steel and consists of a three-chord overhead truss supported on a single leg column with concrete caisson type foundation.

c. Monotube Sign Supports

A sign support that crosses the highway with spans ranging from 13.5 m to

24 m inclusive for lane designation signs. This sign support is suitable for signboard sizes up to and including 1200 mm by 1200 mm. The structure is constructed of galvanised structural steel and consists of four tapered, octagonal monotubes with concrete caisson type foundations

d. VMS Sign Supports

Overhead truss: A sign support that crosses the highway with spans ranging from 17.6 m to 34 m inclusive for variable message sign systems. This sign support is suitable for sign systems up to and including 40 m^2. The structure is constructed of an overhead aluminum truss supported on galvanised structural steel columns with concrete caisson type foundations

Pole mounted: This VMS sign support is fabricated from a galvanised structural steel pole with concrete caisson type foundation. The maximum VMS size is 2400 mm in depth by 4200 mm in width.

e. Bridge Mounted Sign Supports

A sign support mounted on bridges for static signs ranging in depth from 1525 mm to 2740 mm inclusive and width as required. The structure is constructed of aluminium struts and arms connected to the bridge by stainless steel anchors.

Roadside Sign Supports

Roadside sign supports such as steel column and timber sign supports that are currently covered under the SSM will be, in the near future, the responsibility of the MTO Traffic Office. Until such time as the Traffic Office publishes its own structural requirements for these sign supports, the SSM shall continue to be used.

a. Steel Column Sign Supports

A roadside static sign support that can be used for signs ranging in depth from 1200 mm to 3600 mm and in width from 3000 mm to 7800 mm. The structure is constructed of galvanised structural steel and consists of rolled steel crossarms and vertical columns embedded in concrete filled augured holes.

They can be of the breakaway or non-breakaway type.

b. Timber Sign Supports

A roadside static sign support that can be used for signs ranging in depth from 1200 mm to 2700 mm and in width from 2400 mm to 6000 mm. The structure is constructed of pressure preservative treated Douglas Fir or Jack Pine and consists of signboards connected by steel connector plates to two or more timber posts embedded in concrete filled augured holes.

All timber sign supports are of the breakaway or non-breakaway type. Reduced scale copies of the standard drawings for all of the above structures are available in the SSM.

STRUCTURAL MANUAL

DIVISION 3 – DESIGN AIDS

September, 2016

1. INDEX OF DESIGN AIDS

2. GENERAL DESIGN AND DRAFTING

3. PILES

4. FOOTINGS

5. ABUTMENTS, WINGWALLS AND RETAINING WALLS

6. PIERS

7. PRESTRESSED CONCRETE

8. STRUCTURAL STEEL

9. DECK AND CURBS

10. BARRIERS AND RAILING SYSTEMS

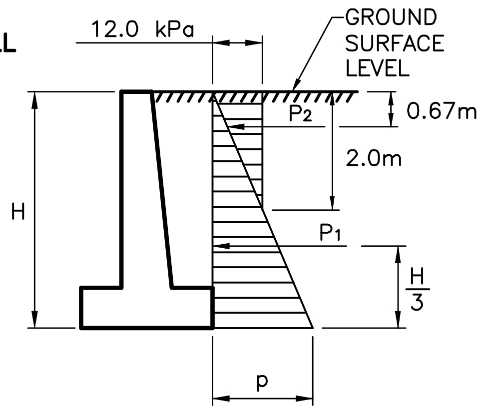
11. RIGID FRAMES

12. REINFORCING STEEL

13. BEARING ASSEMBLIES AND EXPANSION JOINTS

ACTIVE EARTH PRESSURE WITHOUT SURCHARGE

q = EQUIVALENT FLUID PRESSURE (kPa)
p = UNIT PRESSURE AT DEPTH H METRES
P = TOTAL FORCE PER LINEAR METRE OF WALL
M = OVERTURNING MOMENT (kN–m)



AT SERVICEABILITY LIMIT STATES

$\alpha_E = 1.0$
$q = 7.0 \times (H)$

AT ULTIMATE LIMIT STATES

$\alpha_E = 1.25$
$q = 1.25 \times (7.0) \times (H)$

$\phi = 30°$
$P = P_1 + P_2$

– RESULTS INCLUDE THE EFFECT OF COMPACTION SURCHARGE

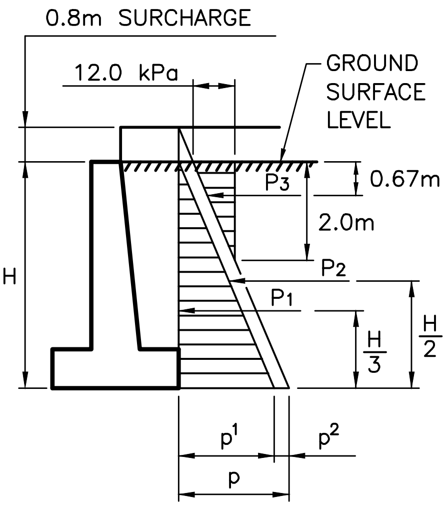
SLS			
H (m)	p (kPa)	P (kN)	M (kN–m)
1.0	7	13	6
1.5	11	19	14
2.0	14	26	25
2.5	18	33	40
3.0	21	44	59
3.5	25	55	84
4.0	28	68	114
4.5	32	83	152
5.0	35	100	197
5.5	39	118	251
6.0	42	138	315

ULS			
H (m)	p (kPa)	P (kN)	M (kN–m)
1.0	9	16	8
1.5	13	24	18
2.0	18	33	31
2.5	22	43	50
3.0	26	55	74
3.5	31	69	105
4.0	35	85	143
4.5	40	104	190
5.0	44	125	246
5.5	48	148	314
6.0	53	173	394

THE METHOD OF EQUIVALENT FLUID PRESSURES IS LIMITED TO A MAXIMUM HEIGHT OF 6.0m. FOR RETAINING WALLS WITH HEIGHTS > 6.0m, THE EARTH PRESSURE DISTRIBUTION SHALL BE ESTABLISHED BY A GEOTECHNICAL ENGINEER.

2016 09 01	ACTIVE EARTH PRESSURE WITH 800mm SURCHARGE	DA 2-11

q = EQUIVALENT FLUID PRESSURE (kPa)
p = UNIT PRESSURE AT DEPTH H METRES
p^1 = UNIT PRESS. DUE TO BACKFILL AT DEPTH H
p^2 = UNIT PRESSURE DUE TO 0.8m SURCHARGE
P = TOTAL FORCE PER LINEAR METRE OF WALL
M = OVERTURNING MOMENT (kN−m)



AT SERVICEABILITY LIMIT STATES

$\alpha_E = 1.0$
$q = 7.0 \times (H)$

AT ULTIMATE LIMIT STATES

$\alpha_E = 1.25$
$q = 1.25 \times (7.0) \times (H)$

$\phi = 30°$
$P = P_1 + P_2 + P_3$
$p = p^1 + p^2$

− RESULTS INCLUDE THE EFFECT OF COMPACTION SURCHARGE

SLS			
H (m)	p (kPa)	P (kN)	M (kN−m)
1.0	13	18	9
1.5	16	28	20
2.0	20	37	37
2.5	23	48	58
3.0	27	60	85
3.5	30	75	118
4.0	34	90	159
4.5	37	108	209
5.0	41	128	268
5.5	44	149	337
6.0	48	172	417

ULS			
H (m)	p (kPa)	P (kN)	M (kN−m)
1.0	16	23	11
1.5	20	35	25
2.0	25	46	46
2.5	29	60	73
3.0	34	75	106
3.5	38	94	148
4.0	43	113	199
4.5	46	135	261
5.0	51	160	335
5.5	55	186	421
6.0	60	215	521

THE METHOD OF EQUIVALENT FLUID PRESSURES IS LIMITED TO A MAXIMUM HEIGHT OF 6.0m. FOR RETAINING WALLS WITH HEIGHTS > 6.0m, THE EARTH PRESSURE DISTRIBUTION SHALL BE ESTABLISHED BY A GEOTECHNICAL ENGINEER.

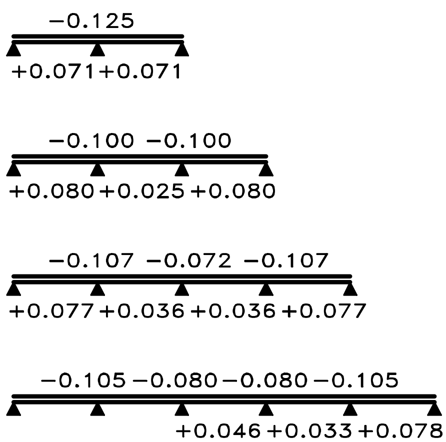
CONTINUOUS BEAMS (EQUAL SPANS)

BENDING MOMENT = coefficient x w x L^2
SHEAR FORCE = coefficient x w x L
w = U.D.L.
L = SPAN

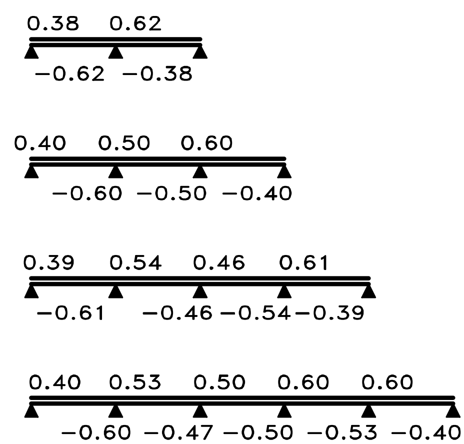
COEFFICIENTS FOR MAXIMUM BENDING MOMENT AND SHEAR

DEAD LOAD (ALL SPANS LOADED)

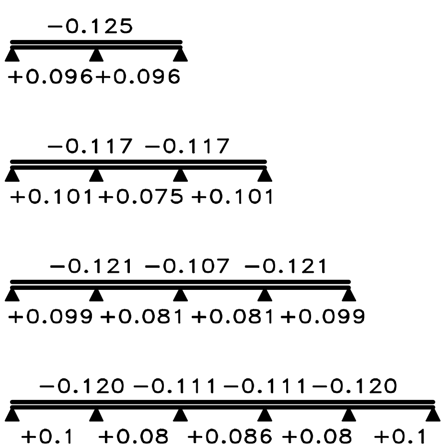
BENDING MOMENT

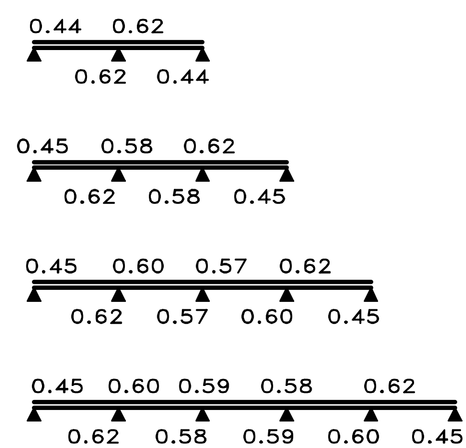


SHEAR

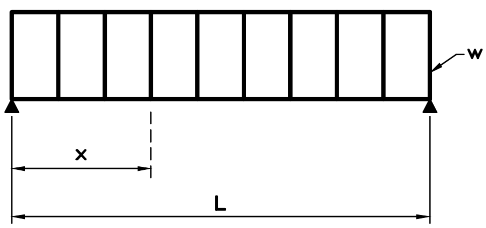


LIVE LOAD
(SEQUENCE OF U.D.L. LOADED SPAN(S) TO GIVE MAX. BENDING MOMENT OR SHEAR)

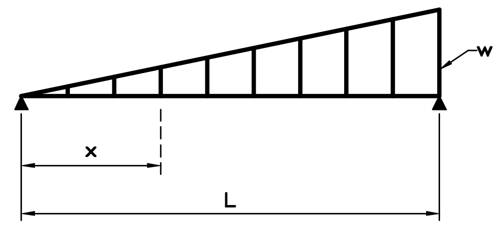




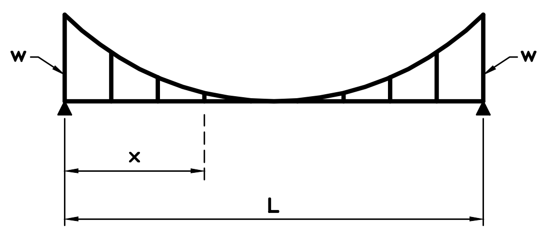
UNIFORM LOAD



TRIANGULAR LOAD

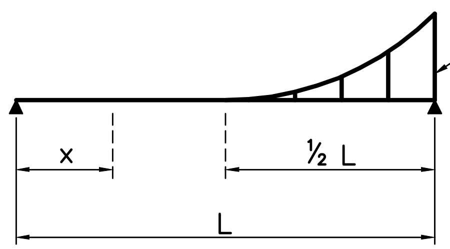


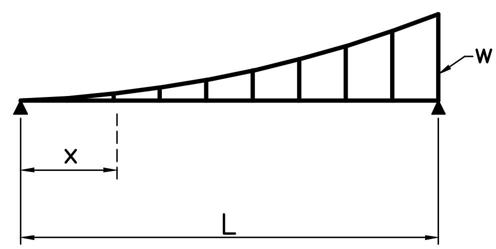
SYMMETRICAL PARABOLIC LOAD



	$\propto$		
$\frac{x}{L}$	UNIFORM LOAD	TRIANGULAR LOAD	SYMMETRICAL PARABOLIC LOAD
0.05	0.02375	0.00831	0.007165
0.10	0.04500	0.01650	0.012300
0.15	0.06375	0.02444	0.015831
0.20	0.08000	0.03200	0.018133
0.25	0.09375	0.03906	0.019531
0.30	0.10500	0.04550	0.020300
0.35	0.11375	0.05119	0.020665
0.40	0.12000	0.05600	0.020800
0.45	0.12375	0.05981	0.020831
0.50	0.12500	0.06250	0.020833
0.55	0.12375	0.06394	0.020831
0.60	0.12000	0.06400	0.020800
0.65	0.11375	0.06256	0.020665
0.70	0.10500	0.05950	0.020300
0.75	0.09375	0.05469	0.019531
0.80	0.08000	0.04800	0.018133
0.85	0.6375	0.03931	0.015831
0.90	0.04500	0.02850	0.012300
0.95	0.02375	0.01544	0.007165

MOMENT $= \propto wL^2$

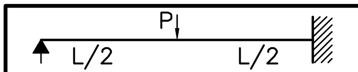
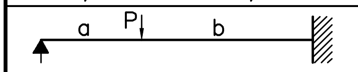
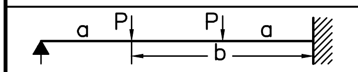
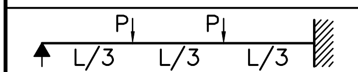
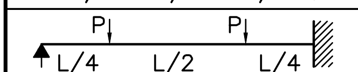
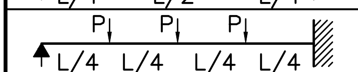
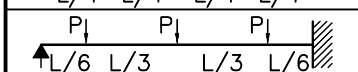
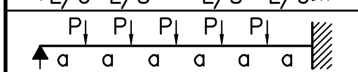
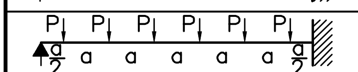
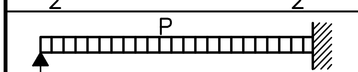
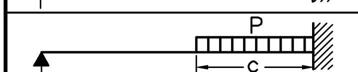
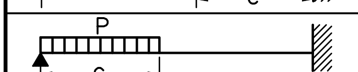
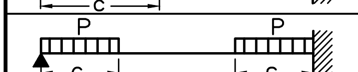
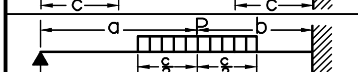
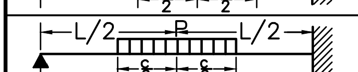
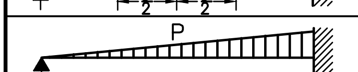
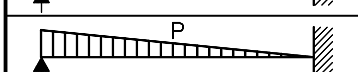
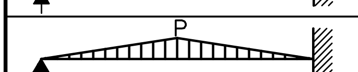
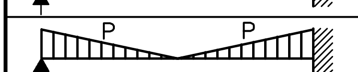
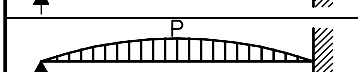
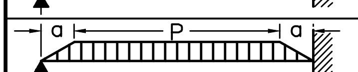
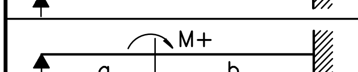




	$\propto$	
$\frac{x}{L}$	PARABOLIC LOAD A	PARABOLIC LOAD B
0.05	0.001042	0.004165
0.10	0.002083	0.008325
0.15	0.003125	0.012457
0.20	0.004167	0.016533
0.25	0.005208	0.020507
0.30	0.006250	0.024325
0.35	0.007292	0.027915
0.40	0.008333	0.031200
0.45	0.009375	0.034082
0.50	0.010417	0.036458
0.55	0.011456	0.038207
0.60	0.012467	0.039200
0.65	0.013373	0.039290
0.70	0.014050	0.038325
0.75	0.014323	0.036132
0.80	0.013967	0.032533
0.85	0.012706	0.027332
0.90	0.010217	0.020325
0.95	0.006123	0.011290

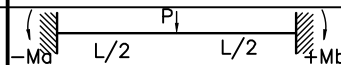
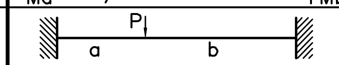
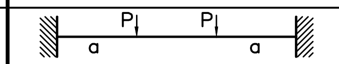
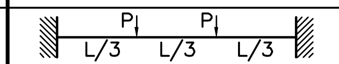
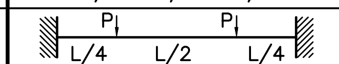
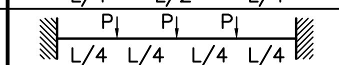
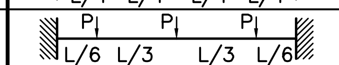
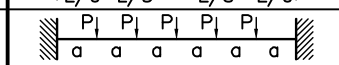
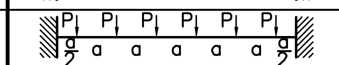
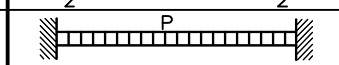
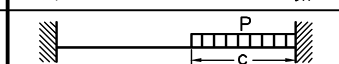
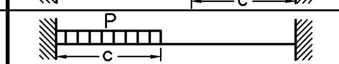
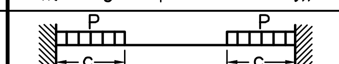
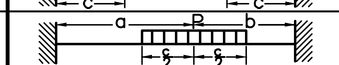
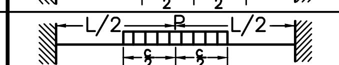
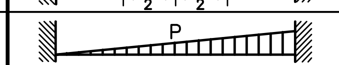
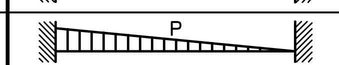
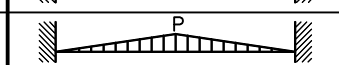
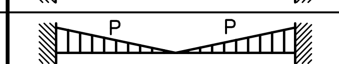
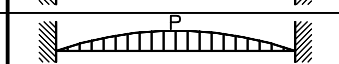
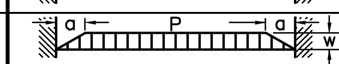
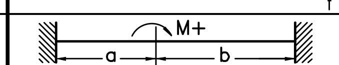
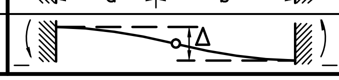
$$\text{MOMENT} = \propto wL^2$$

2016 09 01	FIXED END MOMENTS FOR PRISMATIC BEAMS	DA 2-15

SIMPLY SUPPORTED — FIXED END	
	$\frac{3}{16}PL$
	$\frac{Pa}{2}\left[1-\left(\frac{a}{L}\right)^2\right]$
	$1.5\ Pa\left(\frac{b}{L}\right)$
	$\frac{PL}{3}$
	$\frac{9}{32}PL$
	$\frac{15}{32}PL$
	$\frac{19}{48}PL$
	$\frac{Pa}{8}(n^2-1)$ n=number of spaces
	$\frac{Pa}{8}(n^2+0.5)$ n=number of loads
	$\frac{PL}{8}$
	$\frac{Pc}{8}\left(2-\frac{c}{L}\right)^2$
	$\frac{Pc}{8}\left[2-\left(\frac{c}{L}\right)^2\right]$
	$\frac{3}{4}\ Pc\ \left(1-\frac{2}{3}\ \frac{c}{L}\right)$
	$\frac{Pa}{8L^2}\left[4b\ (a+L)-c^2\right]$
	$\frac{3}{16}PL\left[1-\frac{1}{3}\left(\frac{c}{L}\right)^2\right]$
	$\frac{PL}{7.5}$
	$\frac{7}{60}PL$
	$\frac{PL}{6.4}$
	$\frac{3}{16}PL$
	$0.15\ PL$
	$\frac{PL^2}{8}\left[1-2\left(\frac{a}{L}\right)^2-\left(\frac{a}{L}\right)^3\right]$
	$\frac{M}{2}\left[1-3\left(\frac{a}{L}\right)^2\right]$
	$\frac{3EI}{L^2}\Delta$

2016 09 01	FIXED END MOMENTS FOR PRISMATIC BEAMS	DA 2-16

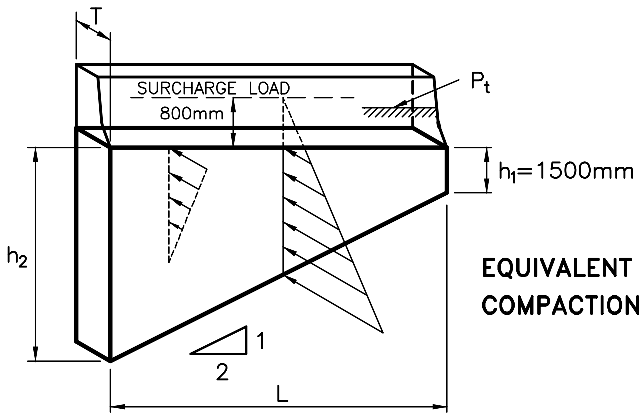
FIXED END FIXED END

Ma	TYPE OF LOADING	Mb
$\frac{PL}{8}$		$\frac{PL}{8}$
$Pa\left(\frac{b}{L}\right)^2$		$Pb\left(\frac{a}{L}\right)^2$
$Pa\left(\frac{L-a}{L}\right)$		$Pa\left(\frac{L-a}{L}\right)$
$\frac{2}{9}PL$		$\frac{2}{9}PL$
$\frac{3}{16}PL$		$\frac{3}{16}PL$
$\frac{5}{16}PL$		$\frac{5}{16}PL$
$\frac{19}{72}PL$		$\frac{19}{72}PL$
$\frac{Pa}{12}(n^2-1)$ n=number of spaces		$\frac{Pa}{12}(n^2-1)$ n=number of spaces
$\frac{Pa}{12}(n^2+0.5)$ n=number of loads		$\frac{Pa}{12}(n^2+0.5)$ n=number of loads
$\frac{PL}{12}$		$\frac{PL}{12}$
$\frac{Pc}{2}\left[\frac{2}{3}\times\frac{c}{L}-\frac{1}{2}\left(\frac{c}{L}\right)^2\right]$		$\frac{Pc}{2}\left[1-\frac{4}{3}\times\frac{c}{L}+\frac{1}{2}\left(\frac{c}{L}\right)^2\right]$
$\frac{Pc}{2}\left[1-\frac{4}{3}\times\frac{c}{L}+\frac{1}{2}\left(\frac{c}{L}\right)^2\right]$		$\frac{Pc}{2}\left[\frac{2}{3}\times\frac{c}{L}-\frac{1}{2}\left(\frac{c}{L}\right)^2\right]$
$\frac{Pc}{2}\left(1-\frac{2}{3}\frac{c}{L}\right)$		$\frac{Pc}{2}\left(1-\frac{2}{3}\frac{c}{L}\right)$
$\frac{Pa}{12L^2}\left[12ab^2+c^2(L-3b)\right]$		$\frac{Pa}{12L^2}\left[12a^2b+c^2(L-3a)\right]$
$\frac{PL}{8}\left[1-\frac{1}{3}\left(\frac{c}{L}\right)^2\right]$		$\frac{PL}{8}\left[1-\frac{1}{3}\left(\frac{c}{L}\right)^2\right]$
$\frac{PL}{15}$		$\frac{PL}{10}$
$\frac{PL}{10}$		$\frac{PL}{15}$
$\frac{PL}{9.6}$		$\frac{PL}{9.6}$
$\frac{PL}{8}$		$\frac{PL}{8}$
$\frac{PL}{10}$		$\frac{PL}{10}$
$\frac{wL^2}{12}\left[1-2\left(\frac{a}{L}\right)^2+\left(\frac{a}{L}\right)^3\right]$		$\frac{wL^2}{12}\left[1-2\left(\frac{a}{L}\right)^2+\left(\frac{a}{L}\right)^3\right]$
$M\frac{b}{L}\left(2-3\frac{b}{L}\right)$		$M\frac{a}{L}\left(2-3\frac{a}{L}\right)$
$\frac{6EI}{L^2}\Delta$		$\frac{6EI}{L^2}\Delta$

$$Mf = [(0.091L^4 + 1.675L^3 + 16.547L^2)/h_2] \times 0.8 + 170(L - 1.05/2)/h_2$$

$$Vf = [(0.365L^3 + 5.031L^2 + 33.094L)/h_2] \times 0.8 + 170/h_2$$

T=400mm



$f'_c = 30$ MPa

$f_y = 400$ MPa

CONCRETE COVER = 70mm

$\phi = 30°$

$P_t = 100$ kN

EQUIVALENT FLUID PRESSURE = γk = 7.0 kPa

COMPACTION SURCHARGE = 12.0 kPa @ SURFACE

= 0.0 kPa @ 1.7m DEPTH

L (m)	Vf (kN/m)	Mf (kN.m/m)	req'd As mm^2	SPACING (mm) 15M	20M	25M
1.50	98	88	800	250	375	—
2.00	97	126	1140	175	250	425
2.50	97	160	1460	—	200	325
3.00	97	194	1800	—	150	275
3.50	100	226	2120	—	—	225
4.00	102	259	2450	—	—	200
4.50	106	292	2800	—	—	175
5.00	110	326	3180	—	—	150
5.50	114	361	3560	30M @ 200		
6.00	119	397	3980	30M @ 175		
6.50	125	436	4420	30M @ 150		
7.00	131	477	4960	35M @ 200		

L length of wingwall

Vf the factored shear force due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall

Mf the factored moment due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall

P_t transverse traffic loads

$\alpha_E^{ULS} = 1.25$

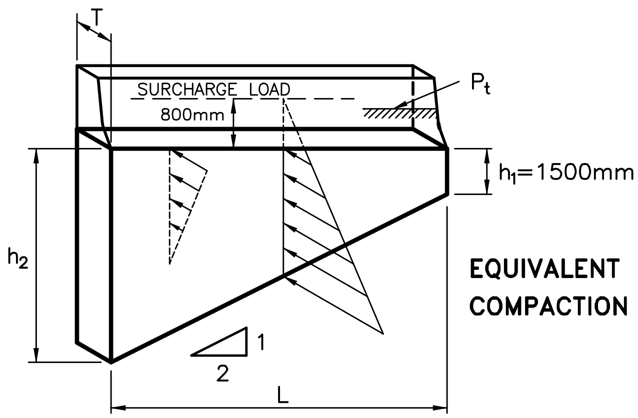
$\alpha_L = 1.70$

NOTES:

- THIS TABLE TO BE READ IN CONJUNCTION WITH DRAWING NUMBER SS105–2.

$$Mf = [(0.091L^4 + 1.675L^3 + 16.547L^2)/h_2] \times 0.8 + 170(L - 1.05/2)/h_2$$

$$Vf = [(0.365L^3 + 5.031L^2 + 33.094L)/h_2] \times 0.8 + 170/h_2$$



T=450mm

f'_c = 30 MPa
f_y = 400 MPa

CONCRETE COVER = 70mm
ϕ = 30°
P_t = 100 kN

EQUIVALENT FLUID PRESSURE = γ k = 7.0 kPa
COMPACTION SURCHARGE = 12.0 kPa @ SURFACE
= 0.0 kPa @ 1.7m DEPTH

L (m)	Vf (kN/m)	Mf (kN.m/m)	req'd As mm^2	SPACING (mm)		
				15M	20M	25M
1.50	98	88	680	275	425	—
2.00	97	126	980	200	300	—
2.50	97	160	1250	150	225	400
3.00	97	194	1540	—	175	325
3.50	100	226	1810	—	150	275
4.00	102	259	2100	—	—	225
4.50	106	292	2370	—	—	200
5.00	110	326	2670	—	—	175
5.50	114	361	2980	30M @ 225		
6.00	119	397	3320	30M @ 200		
6.50	125	436	3680	30M @ 175		
7.00	131	477	4080	30M @ 150		

L length of wingwall
Vf the factored shear force due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall
Mf the factored moment due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall
P_t transverse traffic loads
α_E^{ULS} = 1.25
α_L = 1.70

NOTES:
- THIS TABLE TO BE READ IN CONJUNCTION WITH DRAWING NUMBER SS105–2.

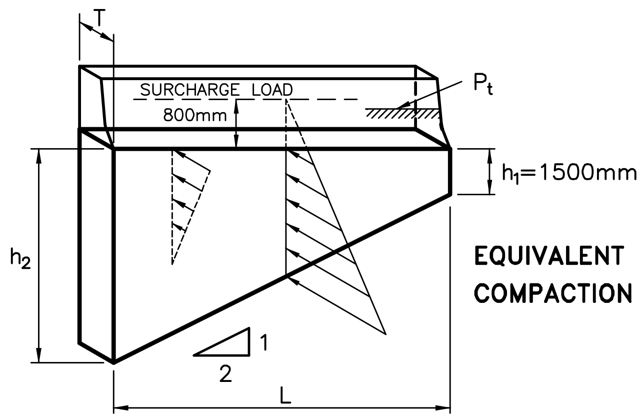
$$Mf = [(0.091L^4 + 1.675L^3 + 16.547L^2)/h_2] \times 0.8 + 170(L - 1.05/2)/h_2$$

$$Vf = [(0.365L^3 + 5.031L^2 + 33.094L)/h_2] \times 0.8 + 170/h_2$$

T=500mm

$f_c' = 30MPa$
$f_y = 400MPa$

CONCRETE COVER = 70mm
$\phi = 30°$
$P_t = 100$ kN



EQUIVALENT FLUID PRESSURE = γk = 7.0 kPa
COMPACTION SURCHARGE = 12.0 kPa @ SURFACE
= 0.0 kPa @ 1.7m DEPTH

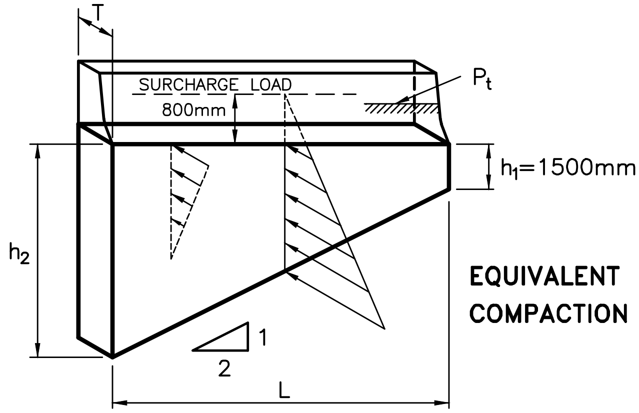
L (m)	Vf (kN/m)	Mf (kN.m/m)	req'd As mm^2	SPACING (mm)		
				15M	20M	25M
1.50	98	88	750	250	400	—
2.00	97	126	860	225	350	—
2.50	97	160	1100	175	250	450
3.00	97	194	1340	150	225	375
3.50	100	226	1570	—	175	300
4.00	102	259	1810	—	150	275
4.50	106	292	2050	—	—	225
5.00	110	326	2310	—	—	200
5.50	114	361	2570	30M @ 250		
6.00	119	397	2850	30M @ 225		
6.50	125	436	3160	30M @ 200		
7.00	131	477	3490	30M @ 200		

L length of wingwall
Vf the factored shear force due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall
Mf the factored moment due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall
P_t transverse traffic loads
$\alpha_E^{ULS} = 1.25$
$\alpha_L = 1.70$

NOTES:
- THIS TABLE TO BE READ IN CONJUNCTION WITH DRAWING NUMBER SS105–2.

$$Mf = [(0.091L^4 + 1.675L^3 + 16.547L^2)/h_2] \times 0.8 + 170(L - 1.05/2)/h_2$$

$$Vf = [(0.365L^3 + 5.031L^2 + 33.094L)/h_2] \times 0.8 + 170/h_2$$



f'_c = 30 MPa

f_y = 400 MPa

T=550mm

CONCRETE COVER = 70mm

ϕ = 30°

P_t = 100 kN

EQUIVALENT FLUID PRESSURE = γk = 7.0 kPa

COMPACTION SURCHARGE = 12.0 kPa @ SURFACE
= 0.0 kPa @ 1.7m DEPTH

L (m)	Vf (kN/m)	Mf (kN.m/m)	req'd As mm^2	SPACING (mm) 15M	20M	25M
1.50	98	88	810	225	350	—
2.00	97	126	810	225	350	—
2.50	97	160	980	200	300	—
3.00	97	194	1190	150	250	400
3.50	100	226	1400	—	200	350
4.00	102	259	1610	—	175	300
4.50	106	292	1820	—	150	275
5.00	110	326	2040	—	—	225
5.50	114	361	2280	30M @ 300		
6.00	119	397	2510	30M @ 275		
6.50	125	436	2770	30M @ 250		
7.00	131	477	3050	30M @ 225		

L length of wingwall

Vf the factored shear force due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall

Mf the factored moment due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall

P_t transverse traffic loads

α_E^{ULS} = 1.25

α_L = 1.70

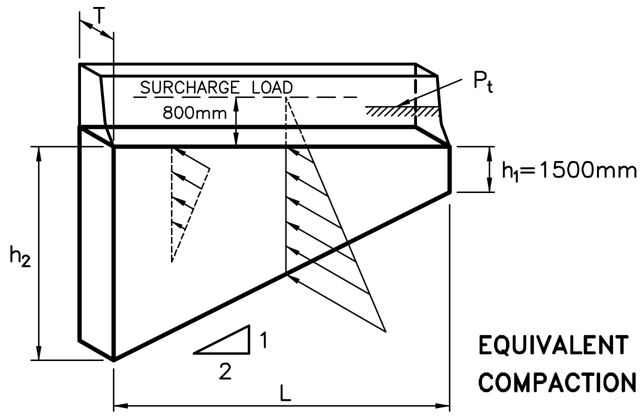
NOTES:

- THIS TABLE TO BE READ IN CONJUNCTION WITH DRAWING NUMBER SS105–2.

WINGWALL DESIGN TABLE

$$Mf = [(0.091L^4 + 1.675L^3 + 16.547L^2)/h_2] \times 0.8 + 170(L - 1.05/2)/h_2$$

$$Vf = [(0.365L^3 + 5.031L^2 + 33.094L)/h_2] \times 0.8 + 170/h_2$$



T=600mm

$f'_c = 30$ MPa

$f_y = 400$ MPa

CONCRETE COVER = 70mm

$\phi = 30°$

$P_t = 100$ kN

EQUIVALENT FLUID PRESSURE = γk = 7.0 kPa

COMPACTION SURCHARGE = 12.0 kPa @ SURFACE

= 0.0 kPa @ 1.7m DEPTH

L (m)	Vf (kN/m)	Mf (kN.m/m)	req'd As mm^2	SPACING (mm)		
				15M	20M	25M
1.50	98	88	870	225	325	—
2.00	97	126	870	225	325	—
2.50	97	160	880	225	325	—
3.00	97	194	1070	175	275	450
3.50	100	226	1250	150	225	400
4.00	102	259	1440	—	200	325
4.50	106	292	1630	—	175	300
5.00	110	326	1820	—	150	275
5.50	114	361	2040	30M @ 325		
6.00	119	397	2250	30M @ 300		
6.50	125	436	2480	30M @ 275		
7.00	131	477	2730	30M @ 250		

L length of wingwall

Vf the factored shear force due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall

Mf the factored moment due to lateral pressure from earth and traffic loads at the fixed end (U.L.S.) per unit height of wall

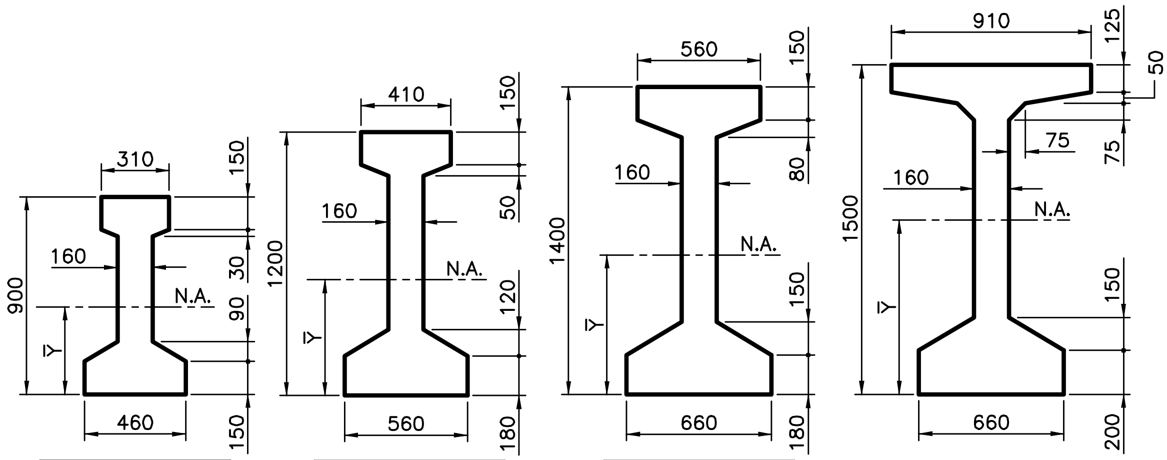
P_t transverse traffic loads

$\alpha_E^{ULS} = 1.25$

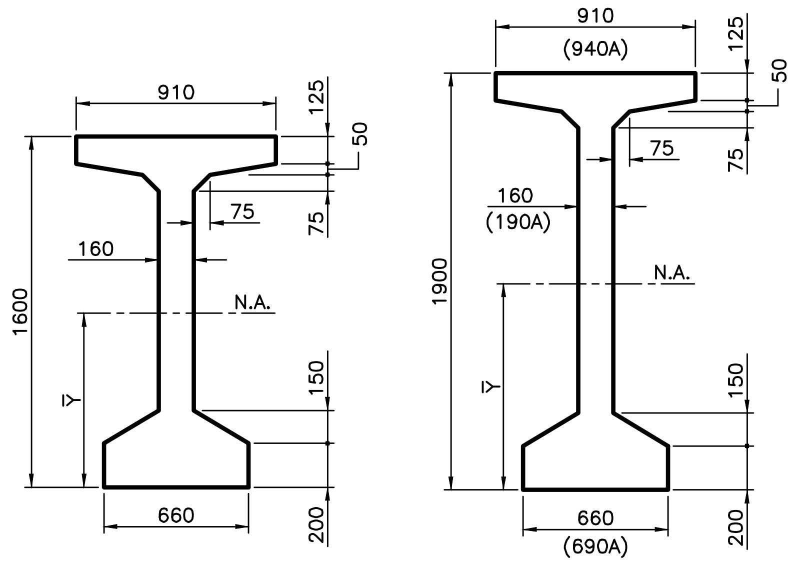
$\alpha_L = 1.70$

NOTES:

- THIS TABLE TO BE READ IN CONJUNCTION WITH DRAWING NUMBER SS105–2.

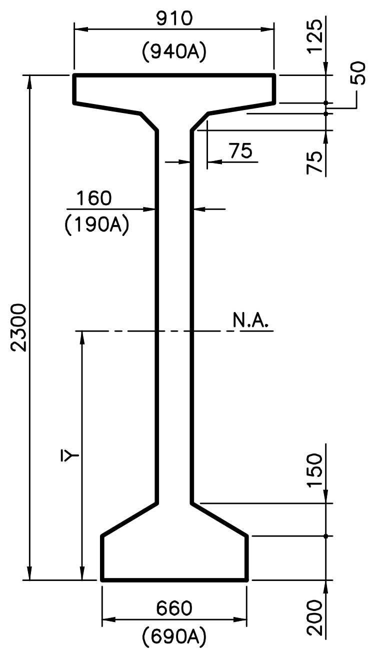


CPCI 900 | CPCI 1200 | CPCI 1400 | CPCI 1500



CPCI 1600

CPCI 1900
CPCI 1900A

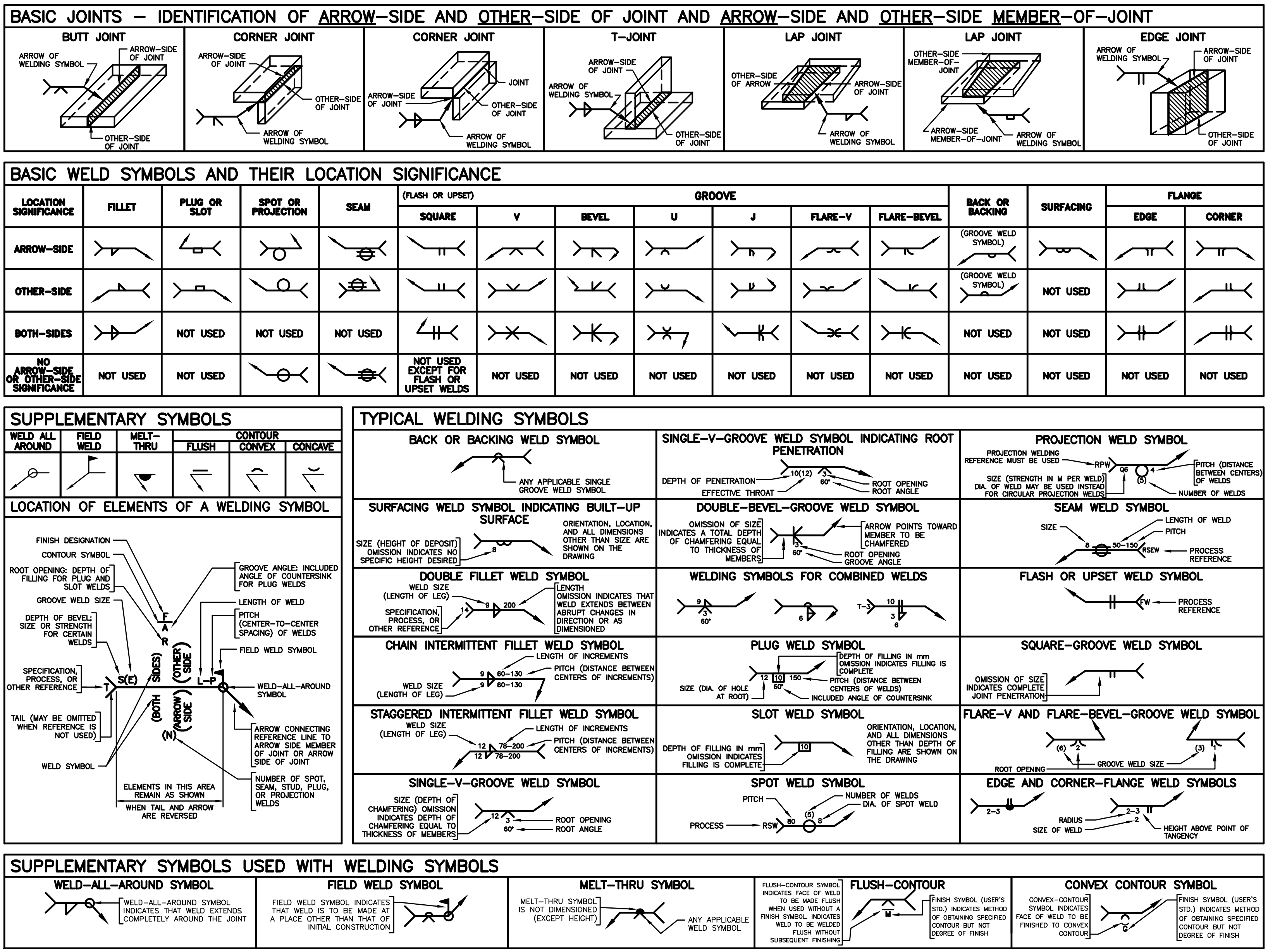


CPCI 2300
CPCI 2300A

SECTION PROPERTIES

TYPE	AREA $\times 10^3 mm^2$	$\overline{Y}$ mm	I $\times 10^6 mm^4$	REMARKS
900	227	400	19943	
1200	332	529	55369	
1400	427	638	104925	
1500*	499	745	151383	*OPTIONAL
1600	515	793	178129	
1900	563	940	274135	
1900A	620	941	291289	POST–TENSIONED
2300	627	1136	441935	
2300A	696	1137	472367	POST–TENSIONED

* OPTIONAL.
SEE SUBSECTION 7.2.2 OF THE STRUCTURAL MANUAL.



AS RECOMMENDED BY CSA-W59 (2013) AND AMERICAN WELDING SOCIETY (2007)

PROPERTIES OF REINFORCING STEEL BARS

BAR SIZE	MASS (kg/m)	NOMINAL DIMENSIONS		
		DIAMETER (mm)	CROSS SECTIONAL AREA (mm^2)	PERIMETER (mm)
10M	0.785	11.3	100	35.5
15M	1.570	16.0	200	50.1
20M	2.355	19.5	300	61.3
25M	3.925	25.2	500	79.2
30M	5.495	29.9	700	93.9
35M	7.850	35.7	1000	112.2
45M	11.775	43.7	1500	137.3
55M	19.625	56.4	2500	177.2

STEEL AREA PER METRE WIDTH (mm^2)

SPACING (mm)	BAR SIZE							
	10M	15M	20M	25M	30M	35M	45M	55M
80	1250	2500	3750	6250	8750	12500	—	—
100	1000	2000	3000	5000	7000	10000	15000	—
120	833	1667	2500	4167	5833	8333	12500	20833
125	800	1600	2400	4000	5600	8000	12000	20000
140	714	1429	2143	3571	5000	7143	10714	17857
150	667	1333	2000	3333	4667	6667	10000	16667
160	625	1250	1875	3125	4375	6250	9375	15625
175	571	1143	1714	2857	4000	5714	8571	14286
180	556	1111	1667	2778	3889	5556	8333	13889
200	500	1000	1500	2500	3500	5000	7500	12500
220	455	909	1364	2273	3182	4545	6818	11364
225	444	889	1333	2222	3111	4444	6667	11111
240	417	833	1250	2083	2917	4167	6250	10417
250	400	800	1200	2000	2800	4000	6000	10000
260	385	769	1154	1923	2692	3846	5769	9615
275	364	727	1091	1818	2545	3636	5455	9091
280	357	714	1071	1786	2500	3571	5357	8929
300	333	667	1000	1667	2333	3333	5000	8333
350	286	571	857	1429	2000	2857	4286	7143
400	250	500	750	1250	1750	2500	3750	6250
450	222	444	667	1111	1556	2222	3333	5556
500	200	400	600	1000	1400	2000	3000	5000

SUBJECT	CONVERSION FACTORS	SUBJECT	CONVERSION FACTORS
LINEAR	1 in. = 25.4 mm 1 ft. = 304.8 mm = 0.3048 m 1 mile = 1.609 km	AREA	1 $in.^2$ = 645.16 mm^2 1 $ft.^2$ = 0.0929 m^2
VOLUME	1 $in.^3$ = 16.3871 cm^3 = 16387.1 mm^3 1 $ft.^3$ = 0.0283 m^3 1 $yd.^3$ = 0.7646 m^3	MASS	1 lb. = 0.4536 kg 1 kip = 453.6 kg 1 ton = 907.2 kg
MASS DENSITY	1 lb./$ft.^3$ = 16.018 kg/m^3 1 lb./$in.^3$ = 27.680 kg/cm^3	FORCE	1 lb. = 4.44822 N 1 kip = 4448.22 N 1 N = 0.10197 kg 1 kg = 9.8067 N 1 kg = 2.2046 lb.
SPEED	1 mi./h = 1.609 km/h 1 ft./s = 0.305 m/s		
LOADS (U.D.L.)	1 kip/in. = 175.1 N/mm 1 kip/ft. = 14.5939 kN/m 1 lb./ft. = 14.5939 N/m	BENDING MOMENT OR TORSION	1 kip·in. = 112.985 N·m 1 kip·ft. = 1.35582 kN·m
PRESSURE OR STRESS OR MODULUS OF ELASTICITY	1 psi = 6.89476 kPa 1 ksi = 6.89476 MPa 1 psf = 47.88 Pa 1 ksf = 47.88 kPa	MOMENT OF INERTIA	1 $in.^4$ = 416231.43 mm^4
		SECTION MODULUS	1 $in.^3$ = 16387.064 mm^3
		TEMPERATURE	°C = 5/9 (°F – 32)
		THERMAL EXPANSION	in./in. °F = 5.556 x 10^{-1} m/m °C

SELECTED SI PREFIXES

Multiplying Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hecto	h
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m

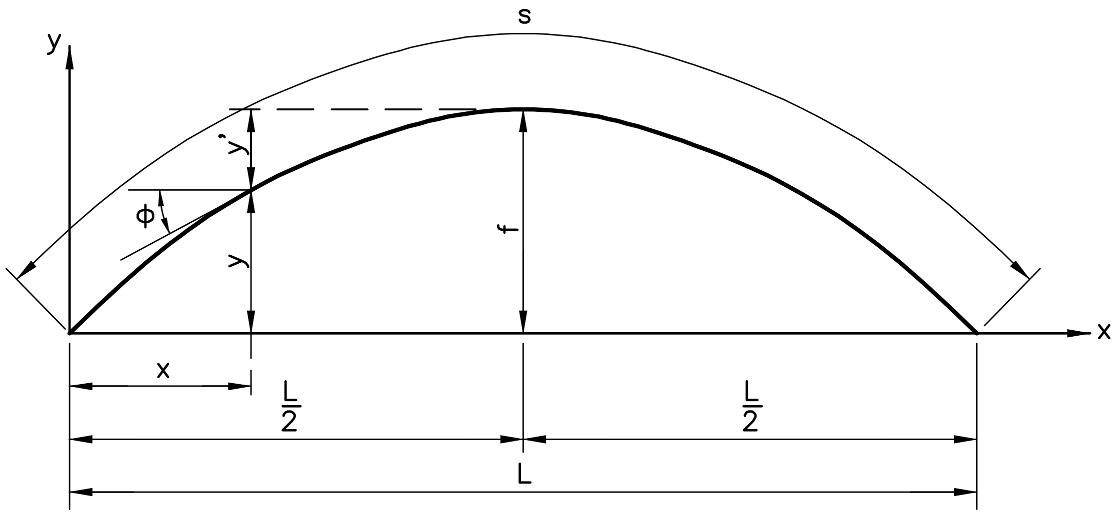
Thermal Coefficient of Linear Expansion for Concrete:

6.667 x 10^{-6}/°F = 12 x 10^{-6} /°C

NOTE:

1 Pa = 1 N/m^2
1 kip = 1000 lb.
1 ton = 2000 lb.
1 metric tonne = 1000 kg

2016 09 01	PROPERTIES OF A PARABOLIC CURVE	DA16-10



$$y = \frac{4f}{L^2}(L-x)x$$

$$\tan\phi = \frac{dy}{dx} = \frac{4f}{L^2}(L-2x)$$

$$s = \left\{\sqrt{1+\left(\frac{4f}{L}\right)^2} + \frac{L}{4f}\log_e\left[\frac{4f}{L} + \sqrt{1+\left(\frac{4f}{L}\right)^2}\right]\right\} \times \frac{L}{2}$$

$\frac{x}{L}$	y	y'
0.05	0.19f	0.81f
0.10	0.36f	0.64f
0.15	0.51f	0.49f
0.20	0.64f	0.36f
0.25	0.75f	0.25f
0.30	0.84f	0.16f
0.35	0.91f	0.09f
0.40	0.96f	0.04f
0.45	0.99f	0.01f
0.50	1.00f	0.00f

$\frac{f}{L}$	s	$\frac{f}{L}$	s
0.05	1.0066L	0.55	1.5560L
0.10	1.0261L	0.60	1.6353L
0.15	1.0571L	0.65	1.7166L
0.20	1.0982L	0.70	1.7997L
0.25	1.1478L	0.75	1.8842L
0.30	1.2043L	0.80	1.9700L
0.35	1.2667L	0.85	2.0570L
0.40	1.3337L	0.90	2.1449L
0.45	1.4047L	0.95	2.2338L
0.50	1.4789L	1.00	2.3234L

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STRUCTURAL MANUAL

DIVISION 4 – STRUCTURAL STANDARD DRAWINGS
SECTION 1

September, 2016

STANDARD DRAWINGS - SMALL SIZE DRAWINGS

The following standard drawings are issued in 216 x 279mm format, for attachment on a full-size standard drawing sheet.

Digital file names are established by removing one "S" from the Standard Drawing name prefix, and adding the extension "DWG". The drawing files are in AutoCAD.

The layer named UPDATE, in the digital file, contains a Revision Information Sheet for the current revision of the drawing.

10. BARRIERS AND RAILING SYSTEMS

11. RIGID FRAMES

12. REINFORCING STEEL

13. BEARING ASSEMBLIES AND EXPANSION JOINTS

14. CULVERTS

15. WOOD STRUCTURES

16. MISCELLANEOUS

17. COMPUTER APPLICATIONS

18. SIGN SUPPORTS

ONTARIO PROVINCIAL STANDARD DRAWINGS - STRUCTURAL

The following Structural OPSD's can be found in the "Ontario Provincial Standards for Roads and Municipal Services" - Volume 3:

9. DECK AND CURBS

10. BARRIERS AND RAILING SYSTEMS

11. RIGID FRAMES

12. REINFORCING STEEL

13. BEARING ASSEMBLIES AND EXPANSION JOINTS

14. CULVERTS

15. WOOD STRUCTURES

16. MISCELLANEOUS

17. COMPUTER APPLICATIONS

18. SIGN SUPPORTS

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LAYER NAME	LINEWEIGHT	AutoCAD COLOUR	PRINCIPLE USE/DESCRIPTION	REPRESENTATION
BORDER	0.75mm	6 (Magenta)	BORDERS AND TITLE-BLOCKS	
DWGINFO	Varies	Varies	DWG FILE INFORMATION	2.0mm TEXT
ST-G-25MM	0.25mm	2 (Yellow)	0.25mm-THICK OBJECT LINES, HIDDEN LINES, AND PHANTOM LINES	
ST-G-30MM	0.30mm	7 (White)	0.30mm-THICK OBJECT LINES, HIDDEN LINES, AND PHANTOM LINES	
ST-G-40MM	0.40mm	3 (Green)	0.40mm-THICK OBJECT LINES, HIDDEN LINES, AND PHANTOM LINES	
ST-G-50MM	0.50mm	4 (Cyan)	0.50mm-THICK OBJECT LINES, HIDDEN LINES, AND PHANTOM LINES	
ST-G-60MM	0.60mm	5 (Blue)	0.60mm-THICK OBJECT LINES, HIDDEN LINES, AND PHANTOM LINES	
ST-G-CENTLN	0.20mm	1 (Red)	CENTRE LINES	
ST-G-CONS	Not to be plotted	53	CONSTRUCTION LINES	
ST-G-DIM	0.20mm	1 (Red)	DIMENSION LINES	
ST-G-HATCH	0.20mm	1 (Red)	HATCH LINES AND PATTERNS	
ST-G-MISC	Varies	Varies	MISCELLANEOUS LAYER FOR LINEWEIGHTS (LESS THAN 0.25mm OR GREATER THAN 0.60mm) AND OTHER FUNCTIONS	
ST-G-SYMBOLS	Varies	Varies	SYMBOLS SUCH AS BALLOON CIRCLES, DETAIL DIAMONDS, SECTION TRIANGLES, AND BREAK LINES.	
ST-G-TEXT	Varies	Varies	ALL TEXT THAT IS NOT IN A LEADER-NOTE OR A DIMENSION	3.5mm TEXT 2.5mm TEXT 2.0mm TEXT
VPORTS	Not to be plotted	4 (Cyan)	VIEWPORTS	

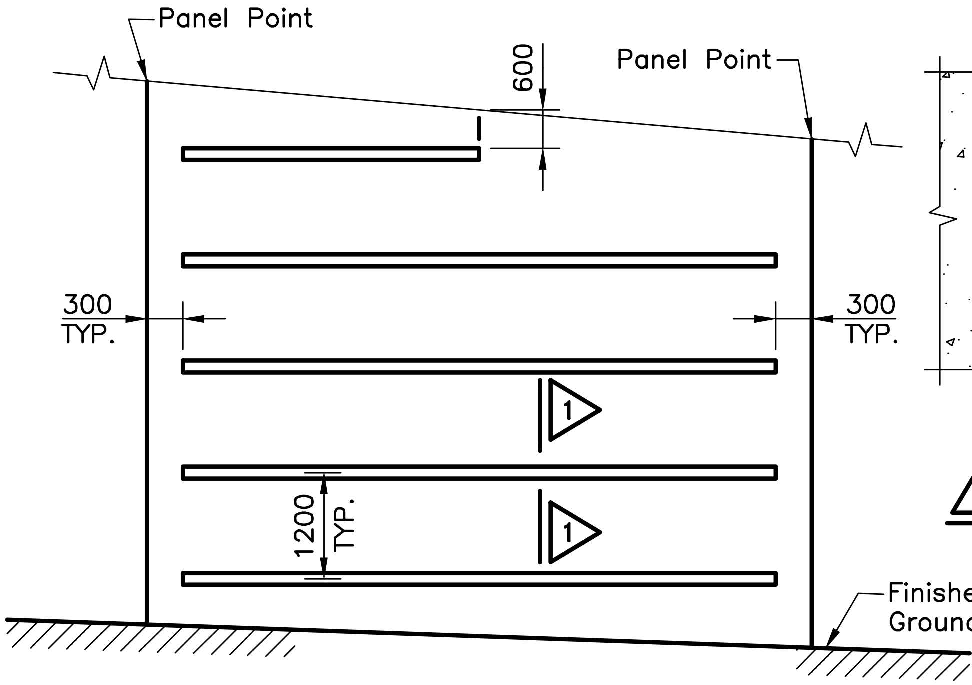
NOTES:

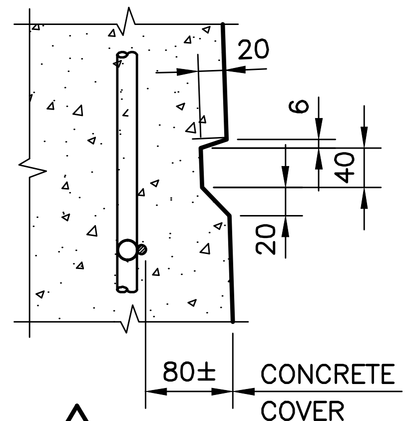
1. THE TABLE ABOVE DESCRIBES ONLY THE COMPLETE LIST OF THE STRUCTURAL-GENERAL (ST-G) LAYERS. REFER TO 'AutoCAD STANDARDS GUIDE, VERSION 2004' FOR ALL STRUCTURAL LAYERS (INCLUDING LAYERS WITH THE 'ST-E' AND 'ST-N' PREFIX).
2. THE 'REPRESENTATION' COLUMN IS APPLICABLE TO A FULL-SIZE (1:1 SCALE) PRINTING.
3. THE COLOUR, LINEWEIGHT, AND HEIGHT OF TEXT ON THE "ST-G-TEXT" LAYER CHANGE IN CONFORMANCE WITH 'AutoCAD STANDARDS GUIDE, VERSION 2004'.

STRUCTURAL STANDARD DRAWINGS
LAYERING STRUCTURE

Date	August 2014	Rev	

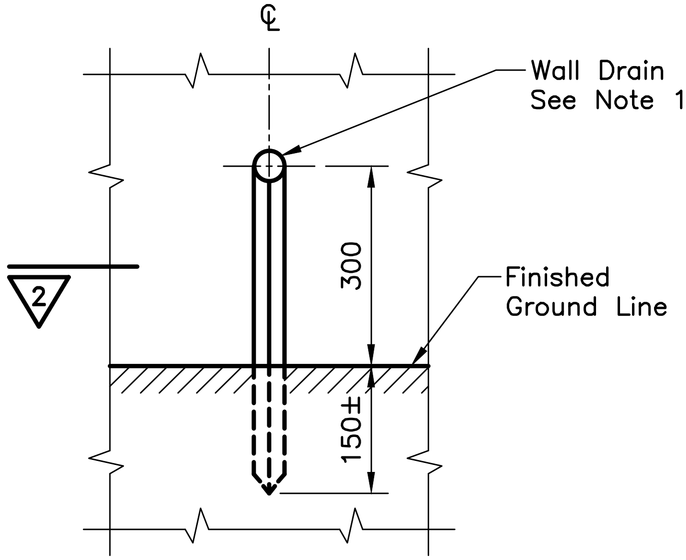
SS2-1

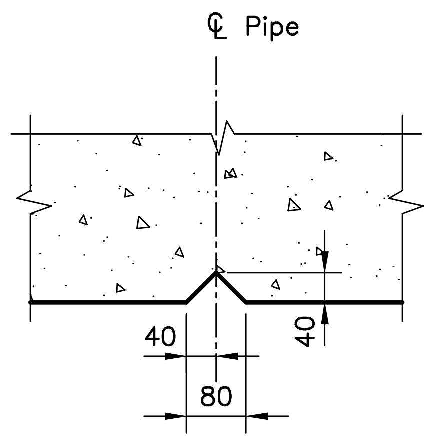




1 SECTION

RETAINING WALL GROOVES





2 SECTION

GROOVE BELOW DRAINS

NOTES:

1. Where specified wall drains shall be installed as per OPSD 3506.000.

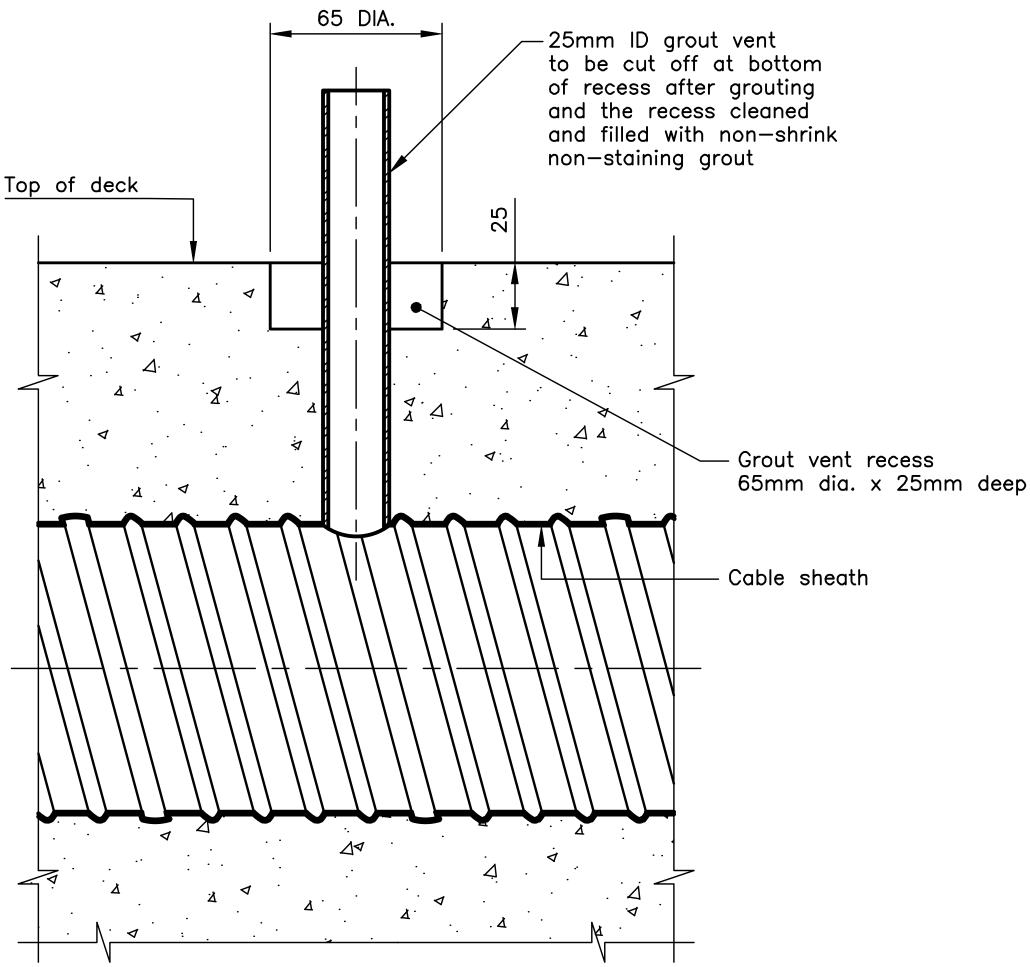
A. All rustication grooves shall be horizontal.

B. All horizontal form panel joints shall coincide with grooves and be completely hidden by them.

C. Horizontal rustication grooves shall be used on fill or toe walls only and when the exposed face exceeds 3000mm.

D. All dimensions are in millimeters unless otherwise specified.

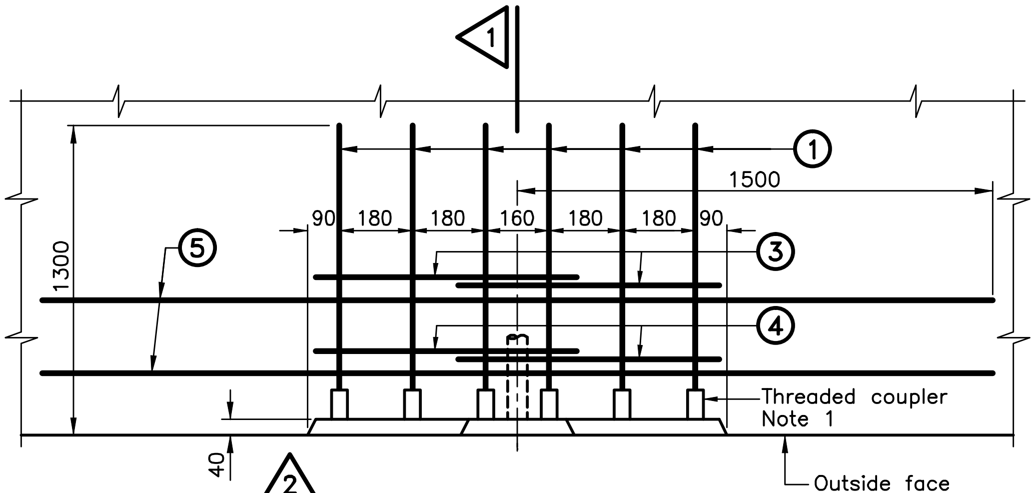
RETAINING WALL – RUSTICATION DETAILS	Date	June 2002	Rev	
	SS5–2			



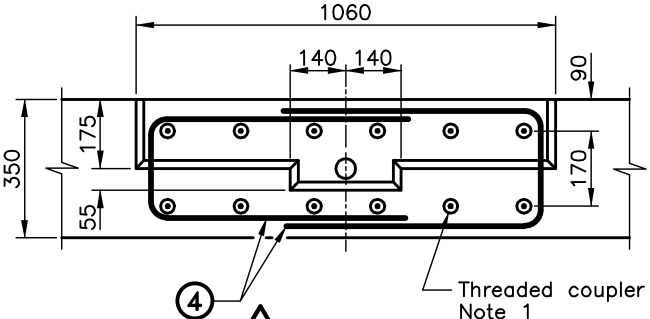
NOTES:

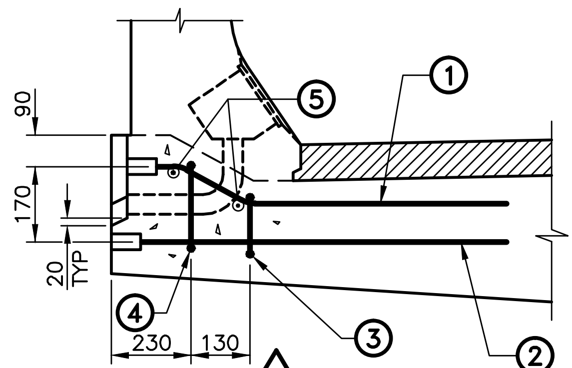
A. All dimensions are in millimetres or metres unless otherwise shown.

GROUT VENT DETAIL	Date	March 2006	Rev	
	SS7–2			



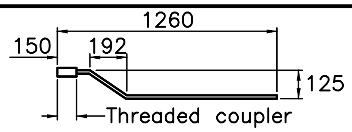
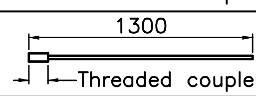
PLAN
(Barrier wall not shown)

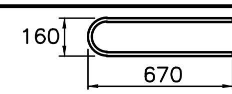
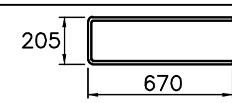
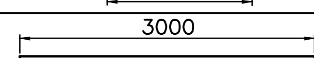




2 **SECTION**

1 **SECTION**

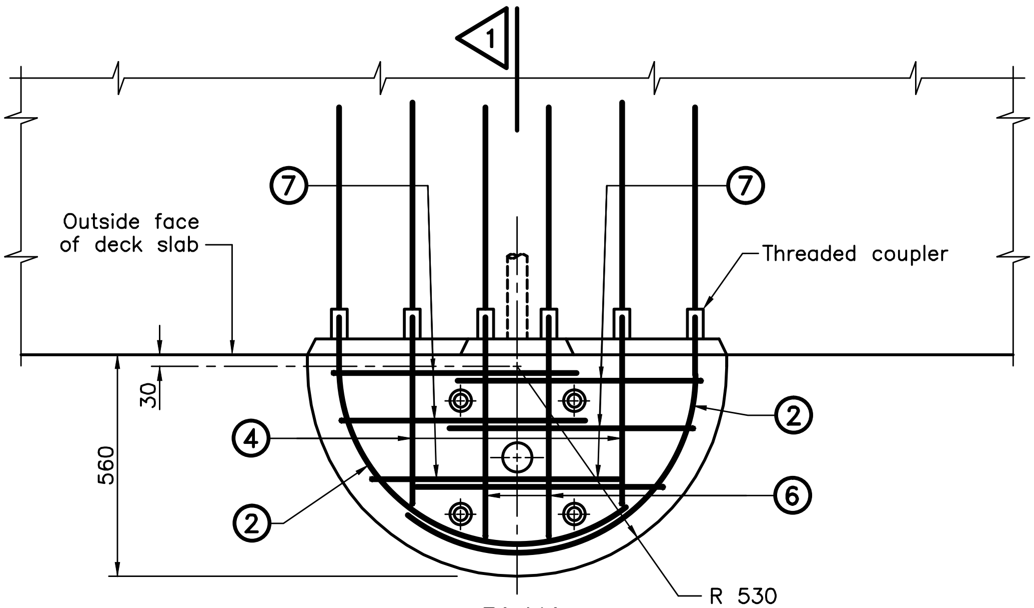
MARK	SIZE	SHAPE
1	S20M	
2	S20M	

MARK	SIZE	SHAPE
3	S15M	
4	S15M	
5	S15M	

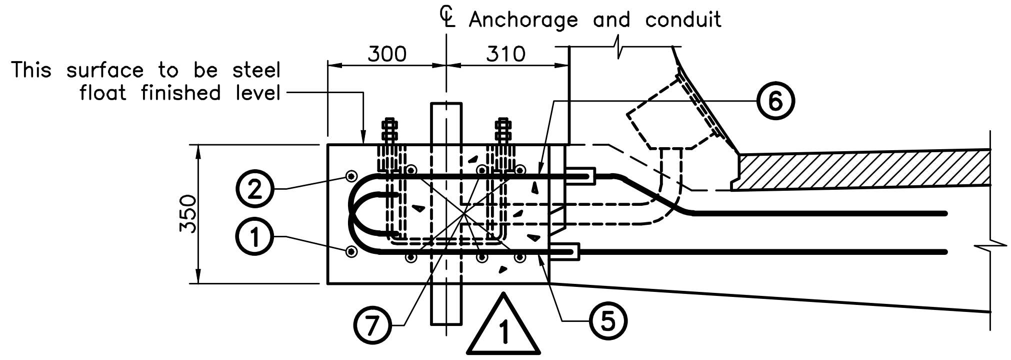
NOTES:

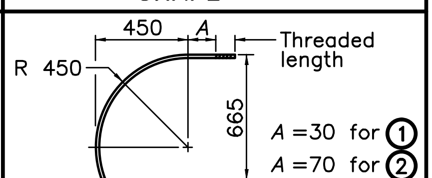
1. Threaded couplers shall be stainless.
2. Reinforcing steel for deck and barrier wall not shown.
3. Reinforcing steel shall be stainless Type 316 LN or Duplex 2205 with a minimum yield strength of 500 MPa.
4. Cover to reinforcing steel 70 ± 20mm.
5. Read in conjunction with SS9–16 and bridge electrical details.
6. Provide galvanized cap–in to threaded couplers and cap on electrical conduit for protection against obstructions until base is cast.
7. All dimensions are in millimetres or metres unless otherwise shown.

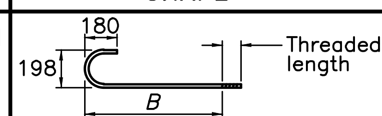
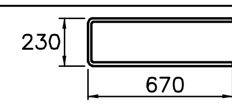
PROVISION FOR FUTURE LIGHT POLE BASE	Date	July 2014	Rev	
	SS9–15			



PLAN
(Barrier wall not shown)



MARK	SIZE	SHAPE
1 2	S20M	 450, A, Threaded length, R 450, 665 A =30 for 1 A =70 for 2

MARK	SIZE	SHAPE
3 4 5 6	S20M	 180, 198, Threaded length, B B =406 for 3 B =480 for 5 B =446 for 4 B =520 for 6
7	S15M	 230, 670

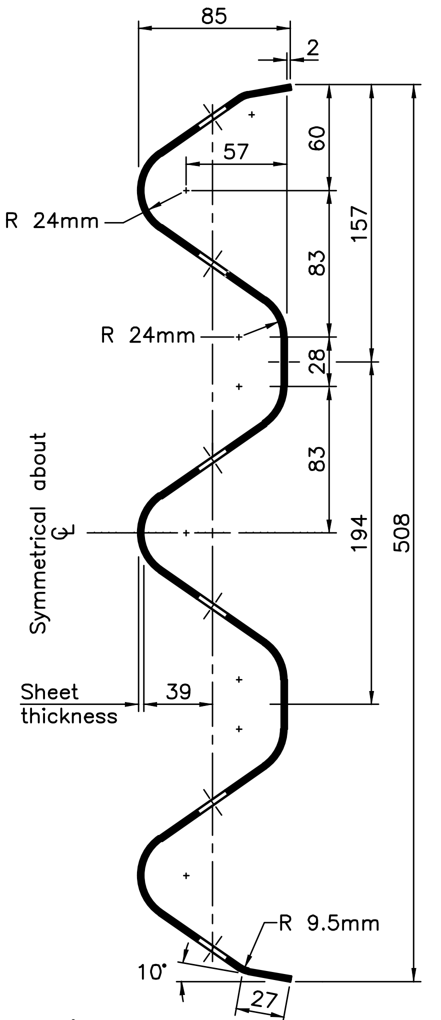
NOTES:

1. Reinforcing steel for deck and barrier wall not shown.
2. Cover to reinforcing steel 70 ± 20mm.
3. Reinforcing steel shall be stainless Type 316 LN or Duplex 2205 with a minimum yield strength of 500 MPa.
4. Read in conjunction with SS9–15 and bridge electrical details.
5. Strength of anchorage based on 4–32mm dia. studs equally spaced on 406mm Bolt Circle Diameter.
6. All dimensions are in millimetres or metres unless otherwise shown.

Date	Jan. 2013	Rev	

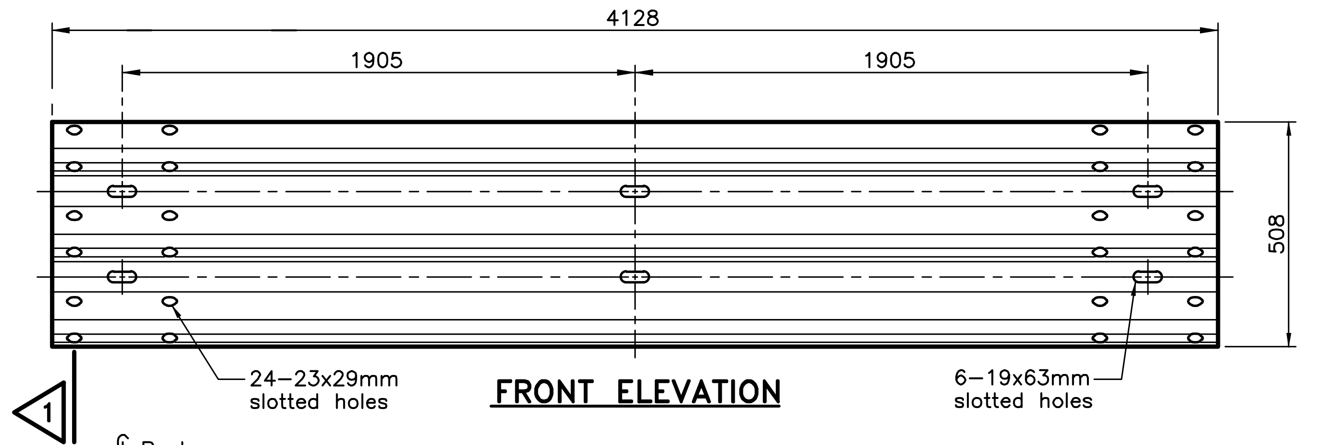
RETROFIT LIGHT POLE BASE

SS9–16

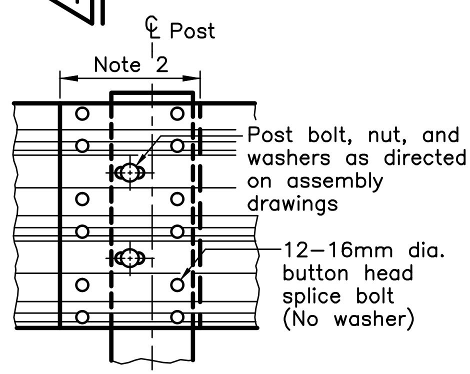


1 ENLARGED SECTION

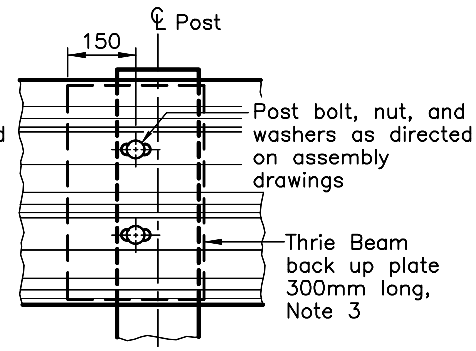
SEE NOTE 1



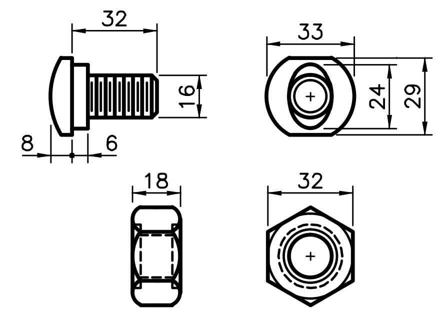
FRONT ELEVATION



SPLICE DETAIL



THRIE BEAM BACK UP PLATE DETAIL



SPLICE BOLT AND NUT

NOTES:

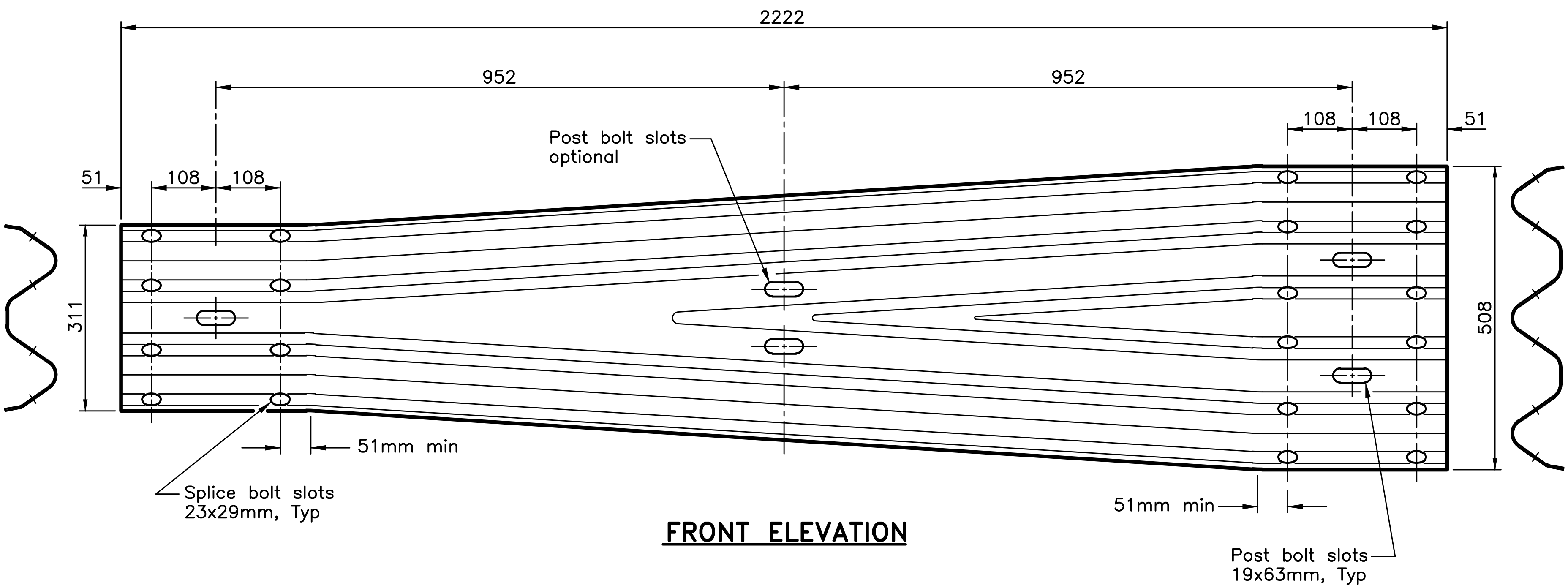
1. Thickness of rail shall be as shown on assembly drawings.
2. Overlap guide rail elements in direction of traffic flow.
3. The 300mm section of Thrie Beam (back up plate) shall be installed at intermediate posts only.

A. Thrie Beam shall conform to AASHTO Specification M180 Type 2.
B. All dimensions subject to manufacturing tolerances unless otherwise indicated.
C. All dimensions are in millimetres or metres unless otherwise shown.

THRIE BEAM GUIDE RAIL
RAIL DETAIL

Date	June 1993	Rev	

SS10–20



FRONT ELEVATION

NOTES:

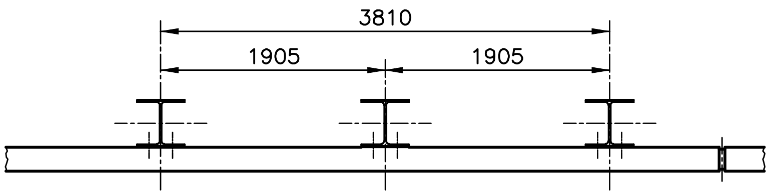
A. This Standard to be read in conjunction with SS10–20 and OPSD 912.101.
B. Overlap guide rail elements in direction of traffic flow.
C. Guide rail elements shall conform to AASHTO Specification M180 Type 2.
D. All dimensions subject to manufacturing tolerances unless otherwise indicated.
E. All dimensions are in millimetres or metres unless otherwise shown.

TRANSITION RAIL

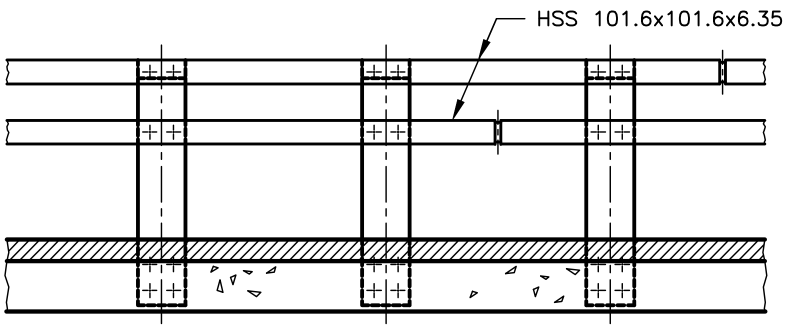
STEEL BEAM GUIDE RAIL TO THRIE BEAM

Date	Sept. 2016	Rev	

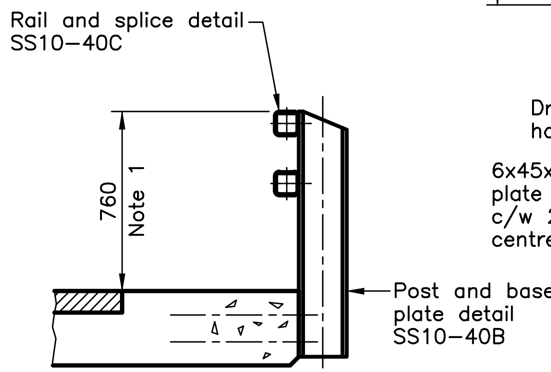
SS10–21



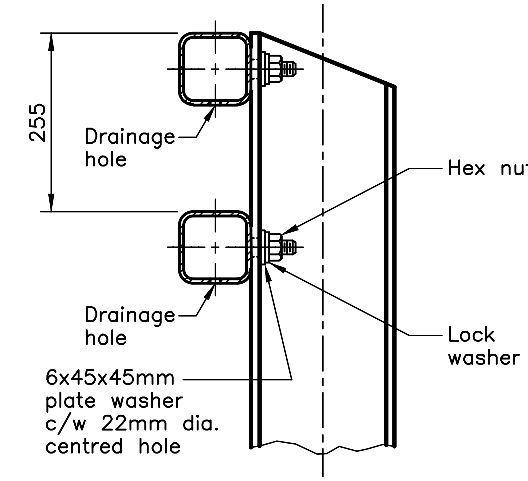
PLAN



ELEVATION



SIDE VIEW



DETAIL

NOTES:

1. Mounting height shall be measured to top of guide rail.

A. This Standard to be read in conjunction with SS10–40B and SS10–40C.

B. Posts shall be vertical. Tubing shall be parallel to vertical alignment.

C. Tubing shall be shop bent to fit horizontal curve when curve radius is less than 290m.

D. Guide rails shall be continuous over not less than 3 intermediate posts, with a minimum length of 3 panels, except as noted.

E. No more than one rail is to be spliced in each panel, except as noted.

F. Space posts to provide 500mm clear between expansion joints and ℄ of post.

G. Rail joints in top and bottom beams at deck expansion joints shall provide allowance for movement equal to width of deck joint with corresponding increase of length of sleeve.

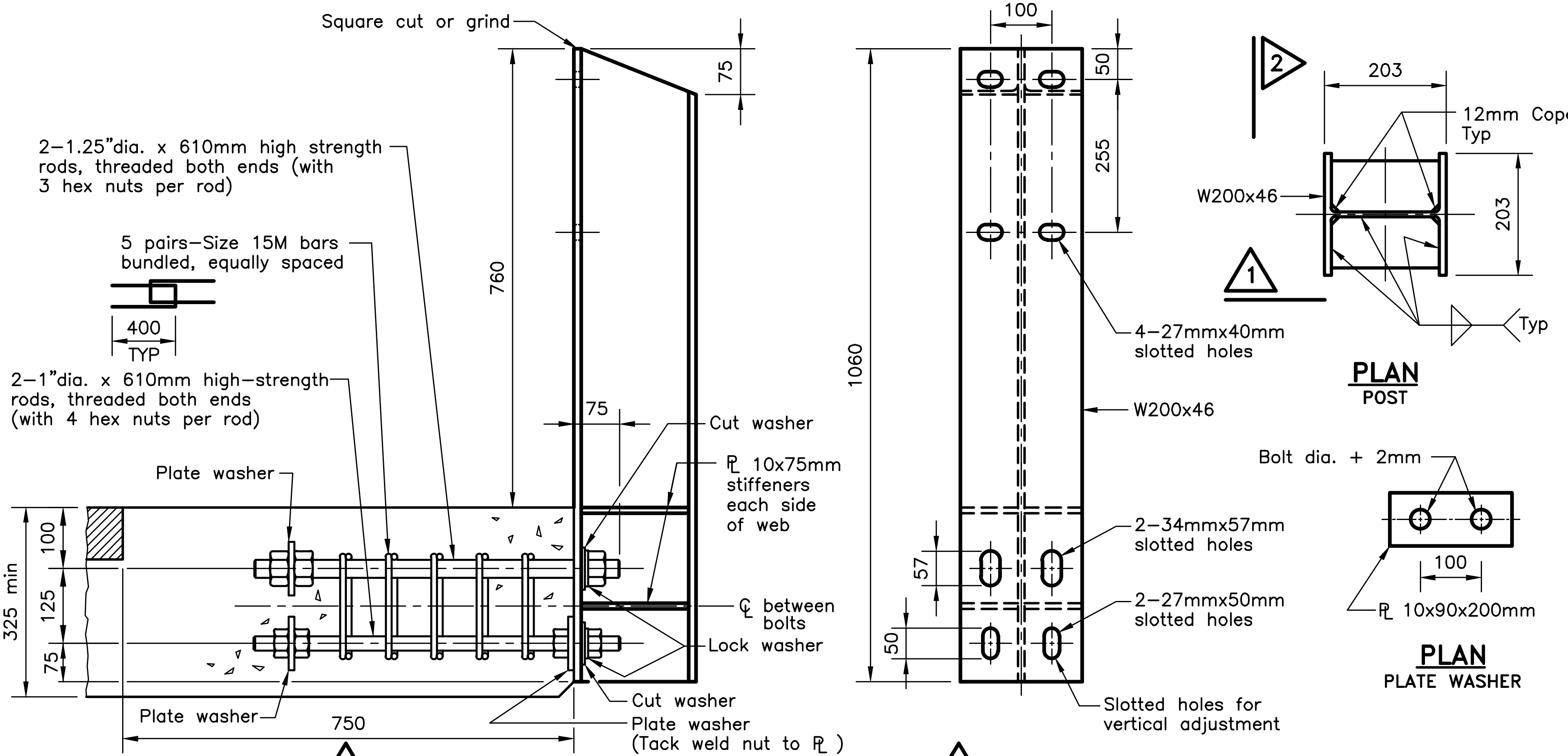
H. Stud bolt nuts shall be torqued to 237 N.m.

J. All dimensions are in millimetres or metres unless otherwise shown.

BOX BEAM GUIDE RAIL – SIDE MOUNT
ASSEMBLY DETAIL
TEST LEVEL 2

Date	Sept. 2016	Rev	

SS10–40A



1 SECTION

2 SECTION

NOTES:

A. This Standard to be read in conjunction with SS10-40A and SS10-40C.

B. W200x46 shall be Grade 350W.

C. Steel plate shall be Grade 300W.

D. Reinforcing steel shall be Grade 400W.

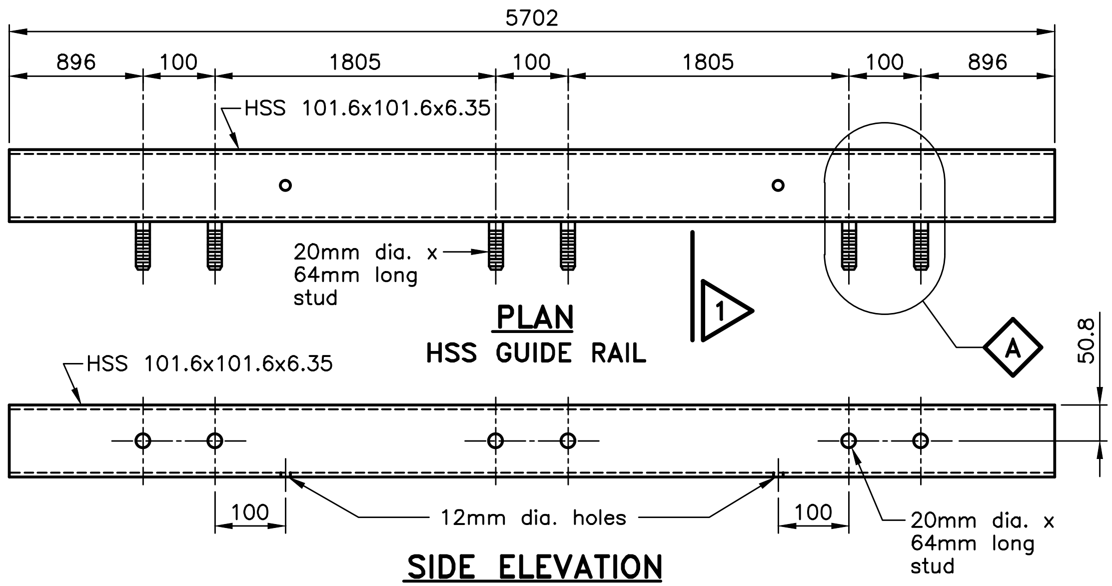
E. Anchor rods shall conform to ASTM Specification A449. They shall be fitted with matching heavy hex nuts and washers.

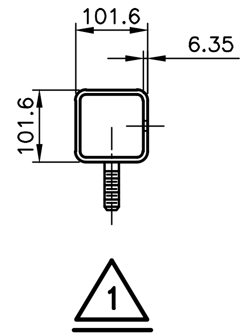
F. Anchor bolt nuts shall be wrench tight.

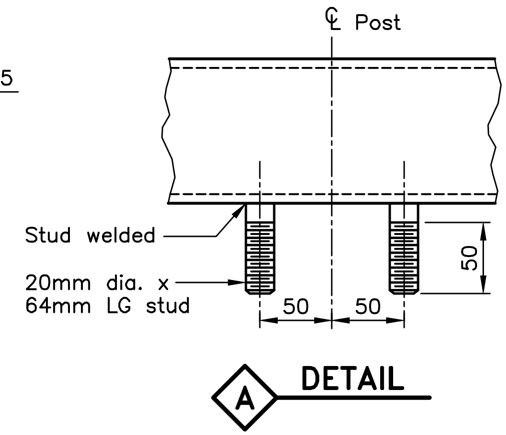
G. The anchorage assembly (including high-strength rods, nuts, and washers), and posts, shall be hot-dip galvanized.

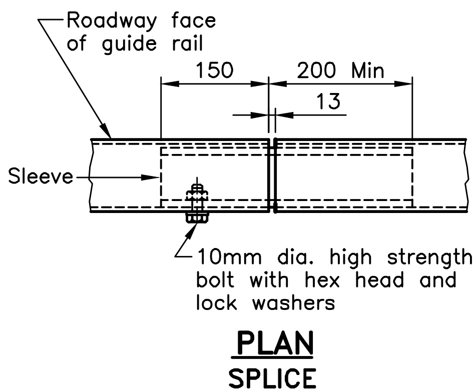
H. All dimensions are in millimetres or metres unless otherwise shown.

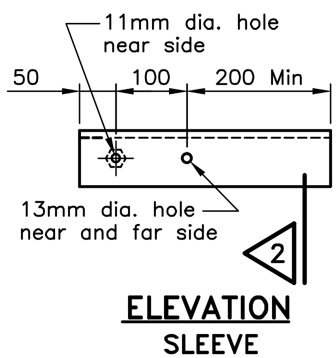
BOX BEAM GUIDE RAIL - SIDE MOUNT **POST AND ATTACHMENT DETAILS** TEST LEVEL 2	Date	Sept. 2016	Rev
	SS10-40B		

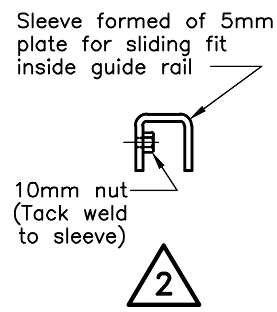


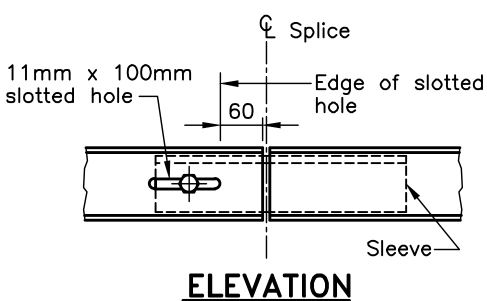












NOTES:

A. This Standard to be read in conjunction with SS10–40A and SS10–40B.

B. HSS guide rail shall be Grade 350W.

C. Steel plate shall be Grade 300W.

D. Stud shall conform to ASTM Specification A108.

E. 10mm nut may be replaced with drilled and tapped hole in sleeve.

F. Welding shall conform to CSA Standard W59–13.

G. HSS guide rail, rail splices, and fasteners shall be hot–dip galvanized after shop fabrication.

H. All dimensions are in millimetres or metres unless otherwise shown.

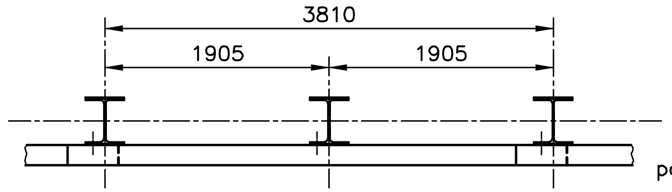
BOX BEAM GUIDE RAIL – SIDE MOUNT

RAIL AND SPLICE DETAIL

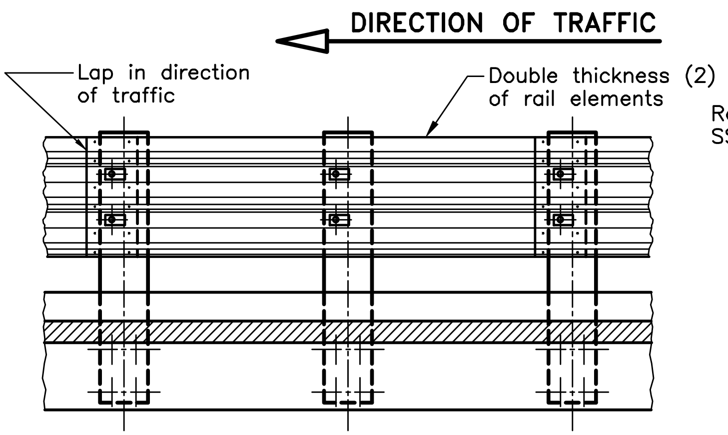
TEST LEVEL 2

Date	Sept. 2016	Rev	

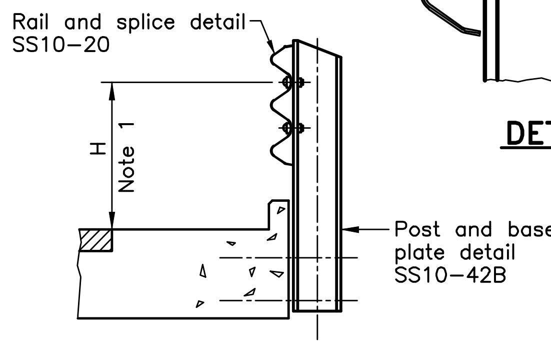
SS10–40C



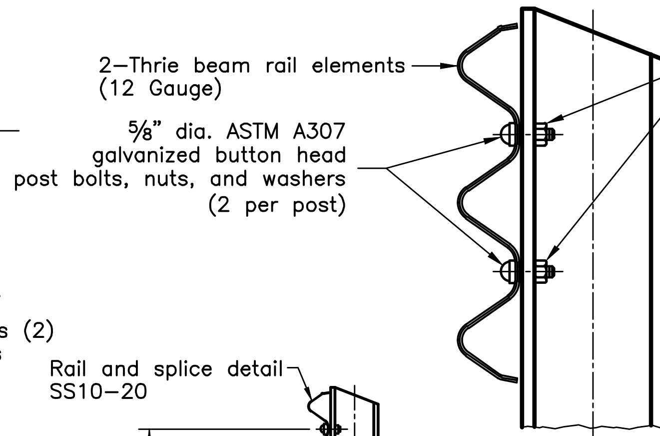
PLAN



ELEVATION



SIDE VIEW



DETAIL

CONNECTION STYLE	"H"
Single Rail	625
Single Rail With Channel	705

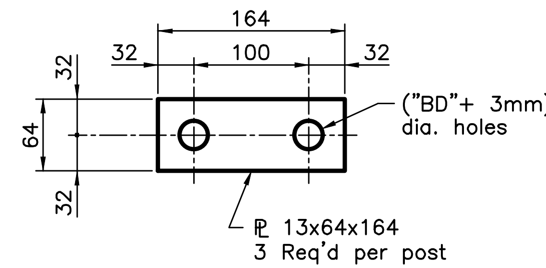


PLATE WASHER "B"

NOTES:

1. Mounting height of thrie beam above deck shall be measured to centre line of top bolt.

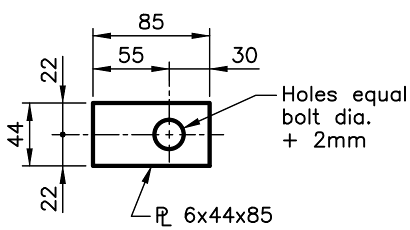
A. This Standard to be read in conjunction with SS10–42B and SS10–20.

B. Railing shall be fabricated to the horizontal and vertical alignment of the structure. Posts shall be installed normal to grade.

C. Post shall be plumbed by shimming with washers for superelevations up to 6%. For superelevations greater than 6% post shall be set normal to roadway surface.

D. Field ream bolt holes in double thickness rail at splice locations. Repair damaged galvanizing with zinc–rich paint.

E. All dimensions are in millimetres or metres unless otherwise shown.



NOTE: Position washer to completely cover slotted hole

PLATE WASHER 'A'

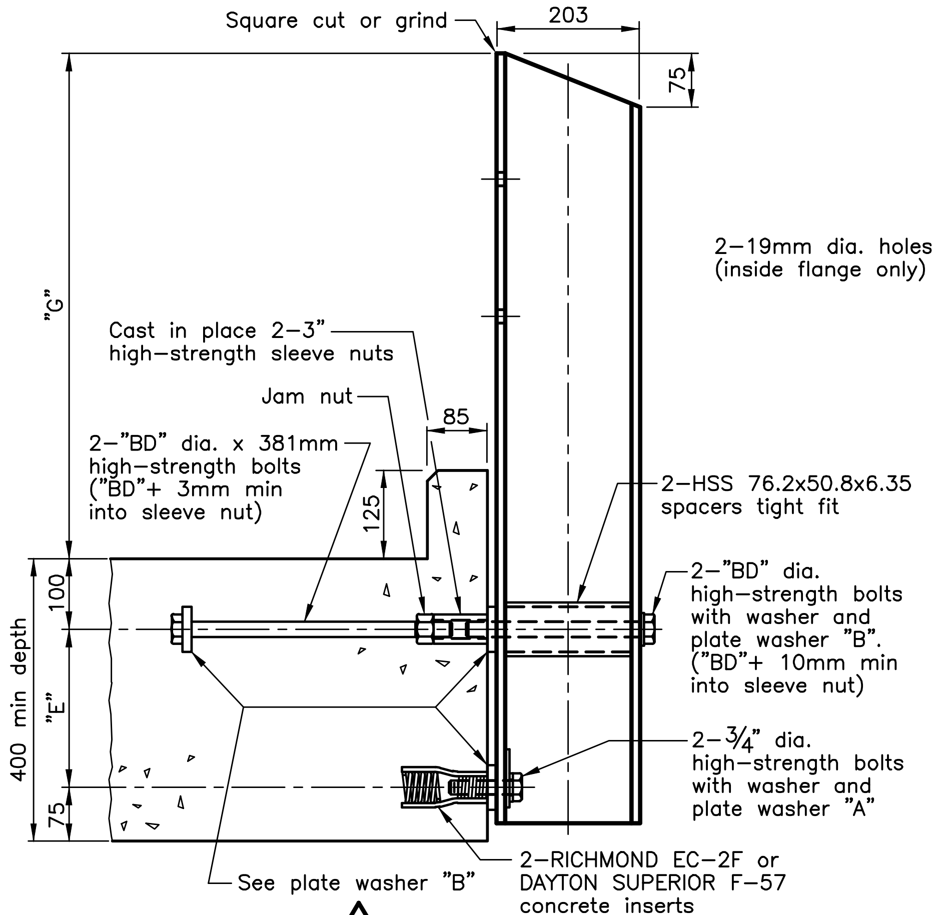
THRIE BEAM GUIDE RAIL – SIDE MOUNT

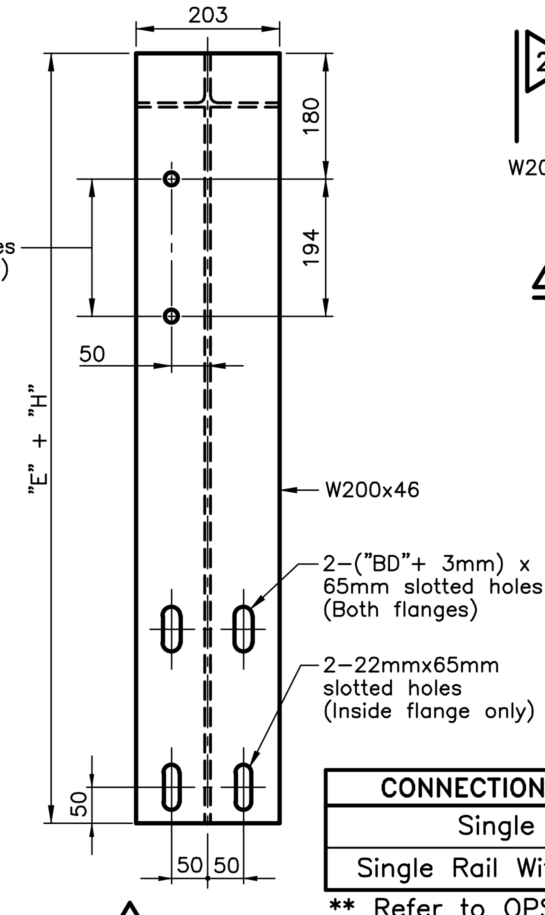
ASSEMBLY DETAIL

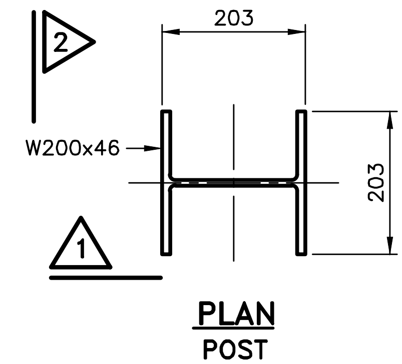
TEST LEVEL 2

Date	Sept. 2016	Rev	

SS10–42A







"E"	"BD"
225	7/8" DIA
300+	3/4" DIA

CONNECTION STYLE **	"G"	"H"
Single Rail	805	955
Single Rail With Channel	885	1035

** Refer to OPSD 912.140

NOTES:

A. This Standard to be read in conjunction with SS10–42A and SS10–20.

B. W200x46 shall be Grade 350W.

C. Steel plate shall be Grade 300W.

D. Anchor bolts shall conform to ASTM Specification A325. They shall be fitted with matching sleeve nuts, heavy hex nuts, and washers.

E. Turn upper high–strength post bolts 2/3–turn past snug–tight condition.

F. Tighten lower high–strength post bolts 1/3–turn past snug condition.

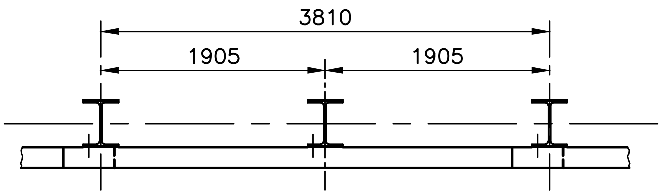
G. The anchorage assembly, (including bolts, nuts, sleeve nut, inserts, and washers), and posts, shall be hot–dip galvanized.

H. All dimensions are in millimetres or metres unless otherwise shown.

THRIE BEAM GUIDE RAIL – SIDE MOUNT
POST AND ATTACHMENT DETAILS
TEST LEVEL 2

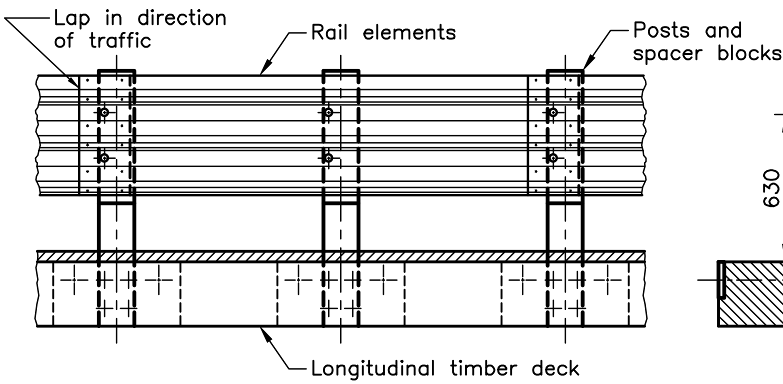
Date	Sept. 2016	Rev

SS10–42B

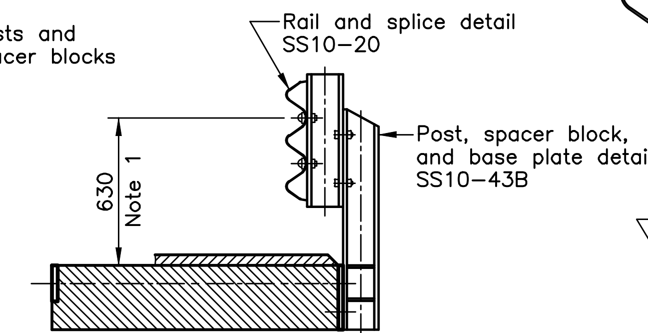


PLAN

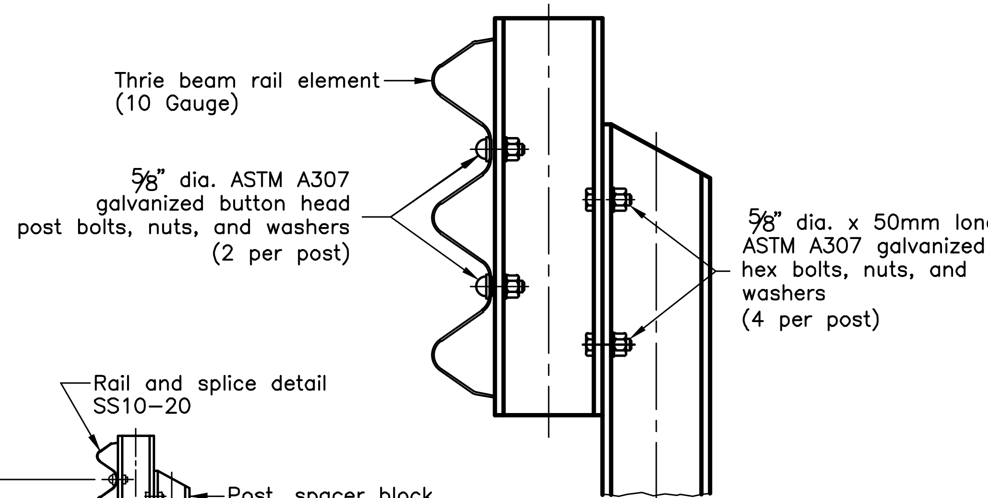
DIRECTION OF TRAFFIC



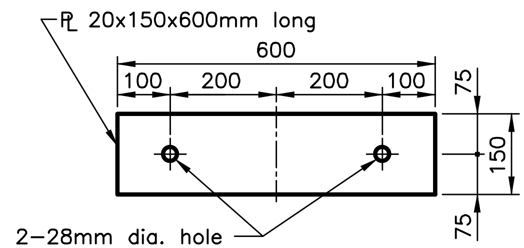
ELEVATION



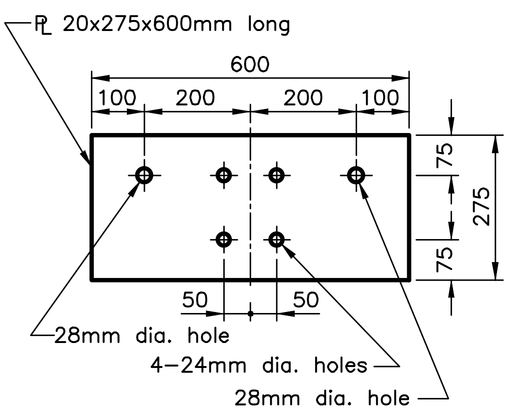
SIDE VIEW



DETAIL



ANCHOR PLATE



STEEL BEARING PLATE

NOTES:

1. Mounting height of thrie beam above deck shall be measured to centre line of top bolt.

A. This Standard to be read in conjunction with SS10-43B and SS10-20.

B. Railing shall be fabricated to the horizontal and vertical alignment of the structure. Posts and spacer blocks shall be installed normal to grade.

C. Field ream bolt holes in rail at splice locations. Repair damaged galvanizing with zinc-rich paint.

D. All dimensions are in millimetres or metres unless otherwise shown.

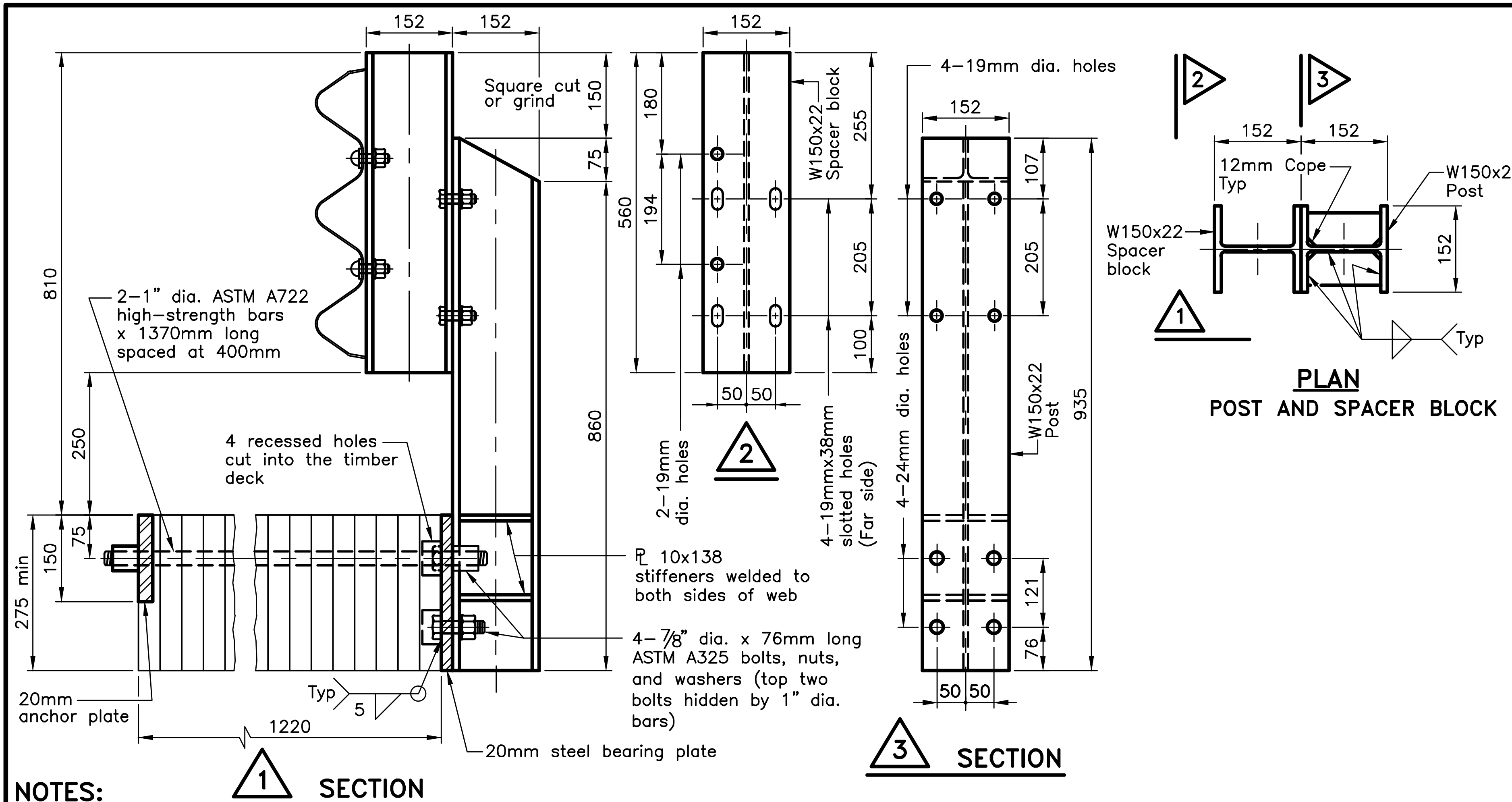
Date	Sept. 2016	Rev	

THRIE BEAM GUIDE RAIL - TIMBER DECK

ASSEMBLY DETAIL

TEST LEVEL 2

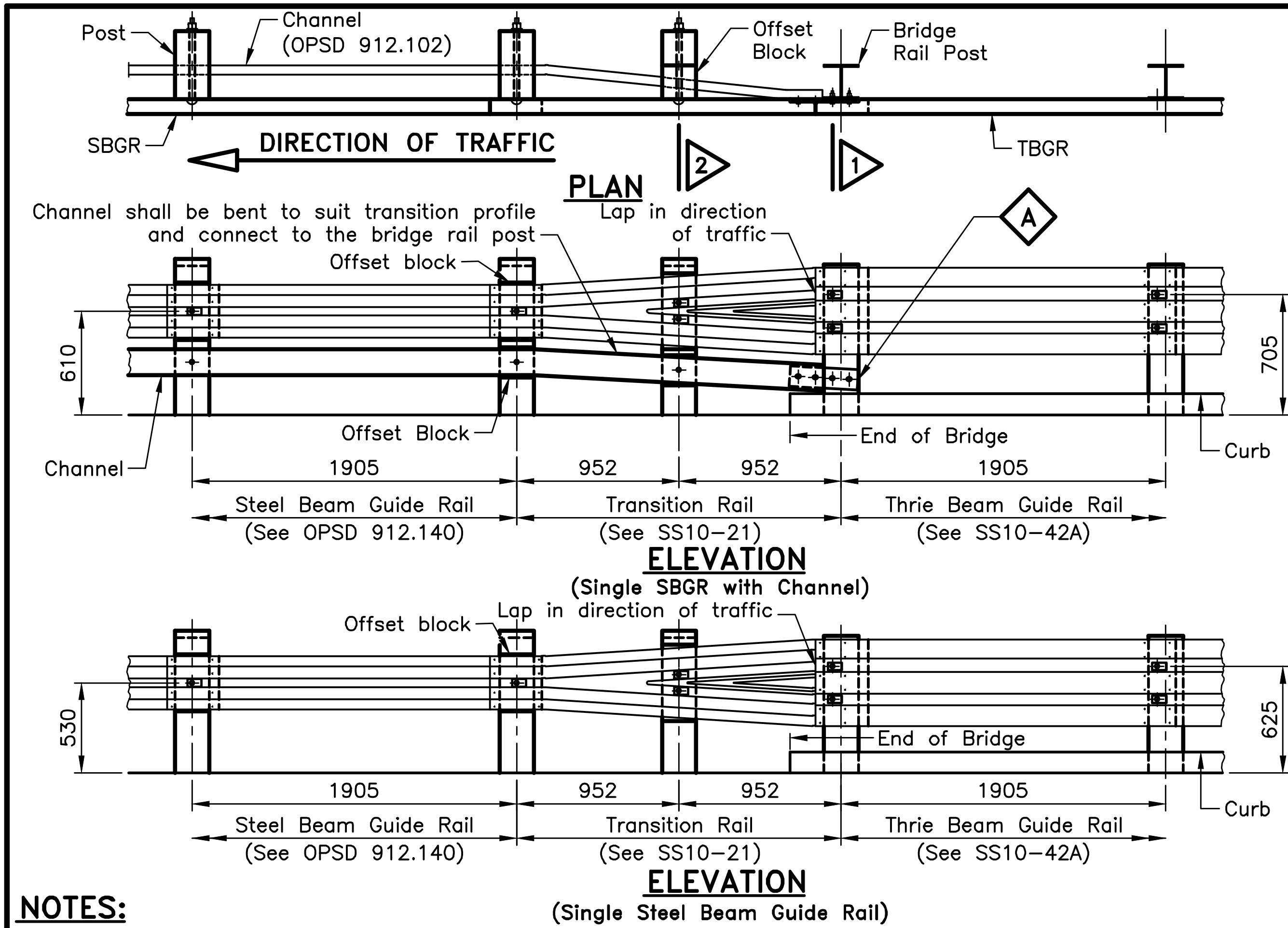
SS10-43A

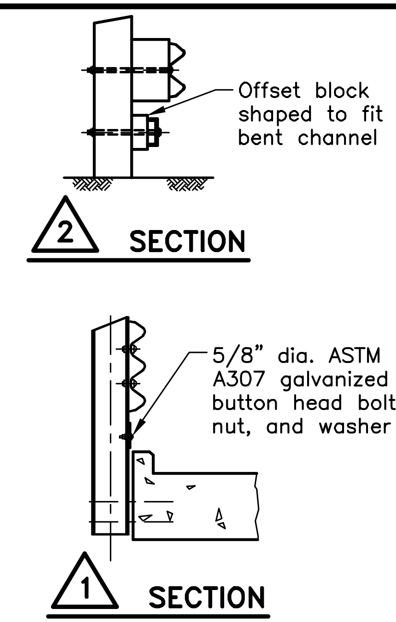


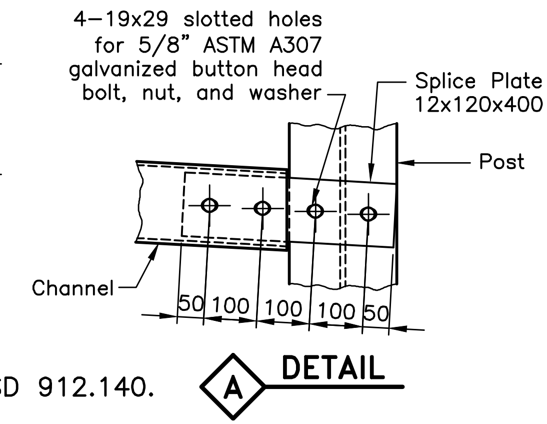
NOTES:

A. This Standard to be read in conjunction with SS10–43A and SS10–20.
B. W150x22 shall be Grade 300W.
C. Steel plate shall be Grade 300W.
D. High–Strength bars shall conform to ASTM Specification A722. They shall be fitted with matching nuts, heavy hex nuts, and washers.
E. High–Strength bolts shall conform to ASTM Specification A325. They shall be fitted with matching heavy hex nuts and washers.
F. All components shall be hot–dip galvanized.
G. All dimensions are in millimetres or metres unless otherwise shown.

THRIE BEAM GUIDE RAIL – TIMBER DECK	Date: Sept. 2016
POST AND ATTACHMENT DETAILS	Rev
TEST LEVEL 2	**SS10–43B**



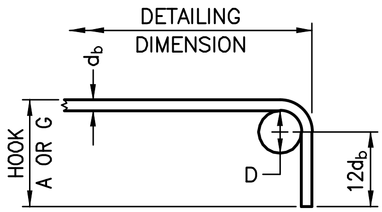




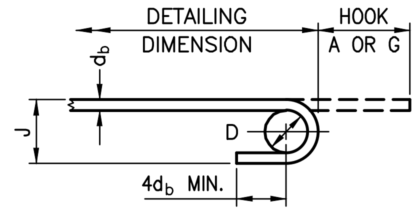
NOTES:

1. This drawing to be read in conjunction with SS10-42A and SS10-21.
2. Additional details of posts, offset blocks, and hardware are shown on SS10-42B and OPSD 912.140.
3. Splice plate shall be Grade 300W.
4. Splice plate shall be hot-dip galvanized.
5. The transition rail should be in line with the bridge rail.
6. The wooden post location of steel beam guide rail shall be adjusted to accommodate a flared end treatment.
7. All dimensions are in millimetres unless otherwise shown.

THRIE BEAM GUIDE RAIL CONNECTION DETAIL STEEL BEAM GUIDE RAIL	Date	July 2014	Rev
	SS10-44		



STANDARD 90° HOOK



STANDARD 180° HOOK

MINIMUM BENDING PIN DIAMETER, D, mm

BAR SIZE	STEEL GRADE	
	400R (2)	400W
10M	70	60
15M	100	90
20M	120	100
25M	150	150
30M	250	200
35M	300	250
45M	450 (1)	400
55M	600 (1)	550

(1) Special fabrication is required for bends exceeding 90° for bars of these sizes and grade.

(2) For stainless steel, with Fy = 500, use the same D as for 400R.

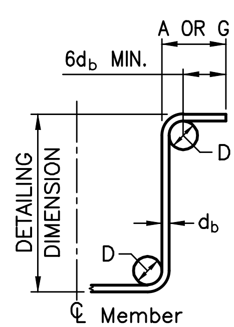
STANDARD HOOK DIMENSIONS

BAR SIZE	90° HOOKS		180° HOOKS			
	A OR G (mm)		A OR G (mm)		J (mm)	
	400R	400W	400R	400W	400R	400W
10M	180	180	140	130	90	80
15M	260	250	180	170	130	120
20M	310	300	220	200	160	140
25M	400	400	280	280	200	200
30M	510	490	400	350	310	260
35M	610	590	480	430	370	320
45M	790	770	680	630	540	490
55M	1030	1010	900	850	710	660

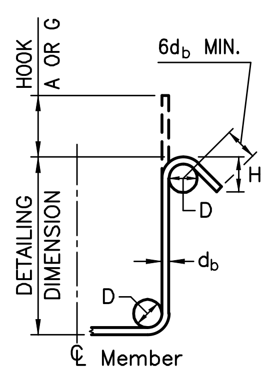
NOTE: All Hook Dimensions are according to the CHBDC–2014.

MINIMUM STIRRUP AND TIE HOOK DIMENSIONS

BAR SIZE	BAR DIAM. d_b(mm)	PIN DIAM. D(mm)	90°	135°	
			A OR G (mm)	A OR G (mm)	H (approx.) (mm)
10M	11.3	45	100	100	70
15M	16.0	65	140	140	100
20M	19.5	80	180	175	115
25M	25.2	100	230		



MIN. 90° HOOK

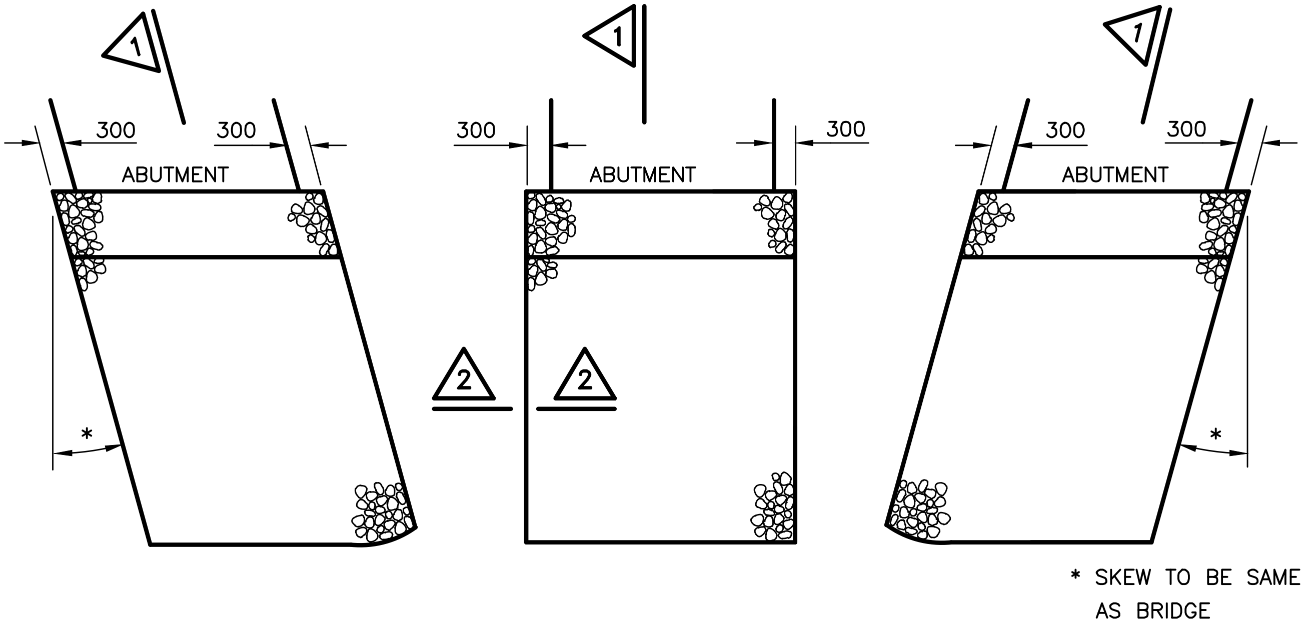


MIN. 135° HOOK

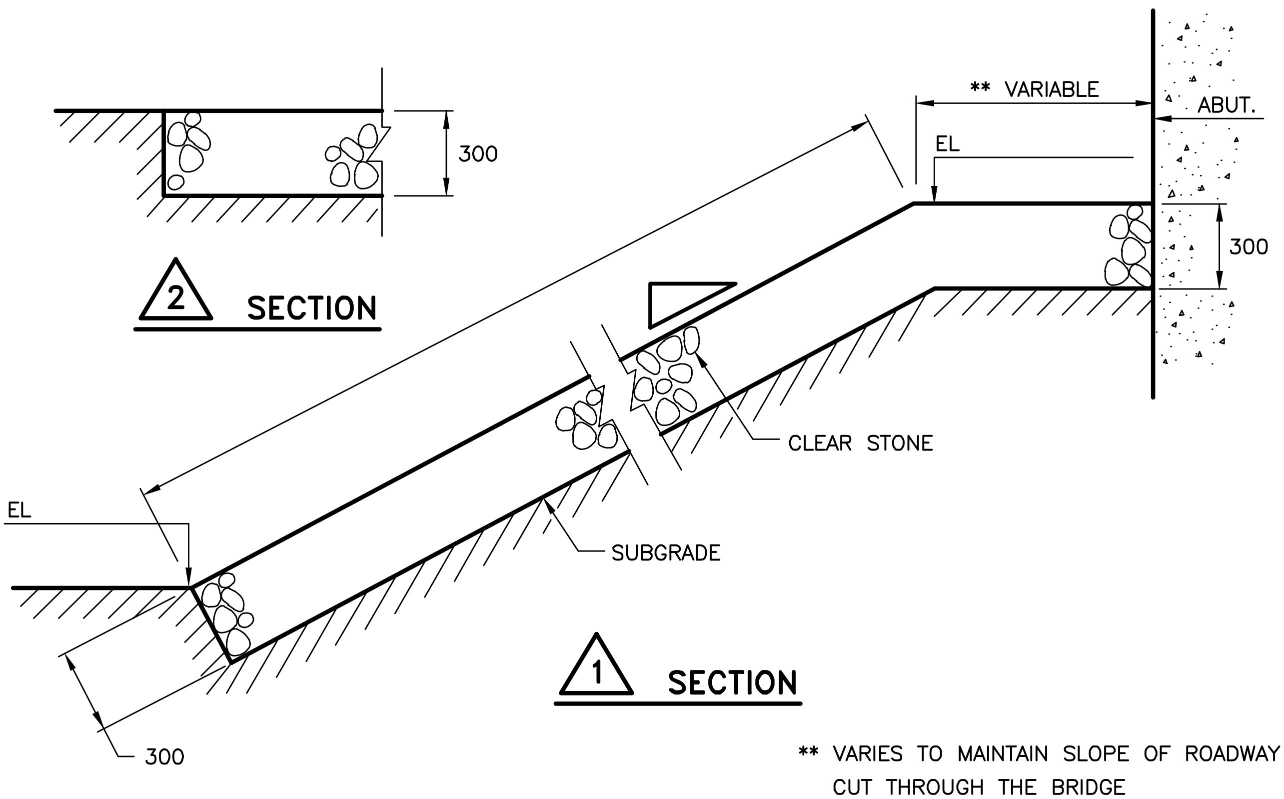
Date	Sept. 2016	Rev	

HOOK DIMENSIONS FOR REINFORCING STEEL BARS

SS12-1



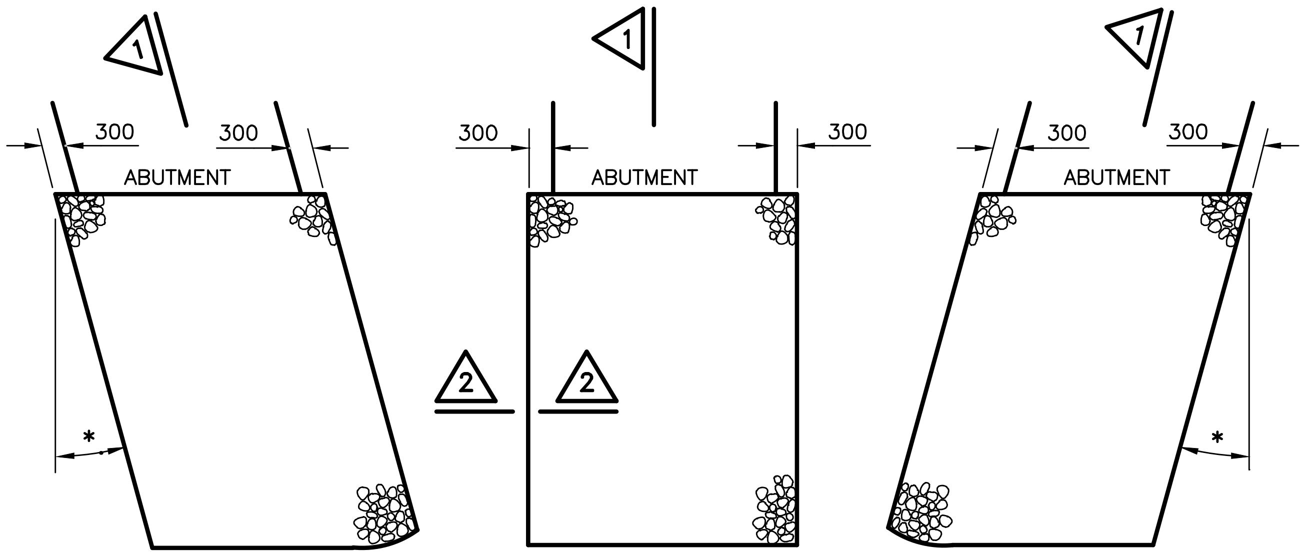
SLOPE PROTECTION LAYOUTS



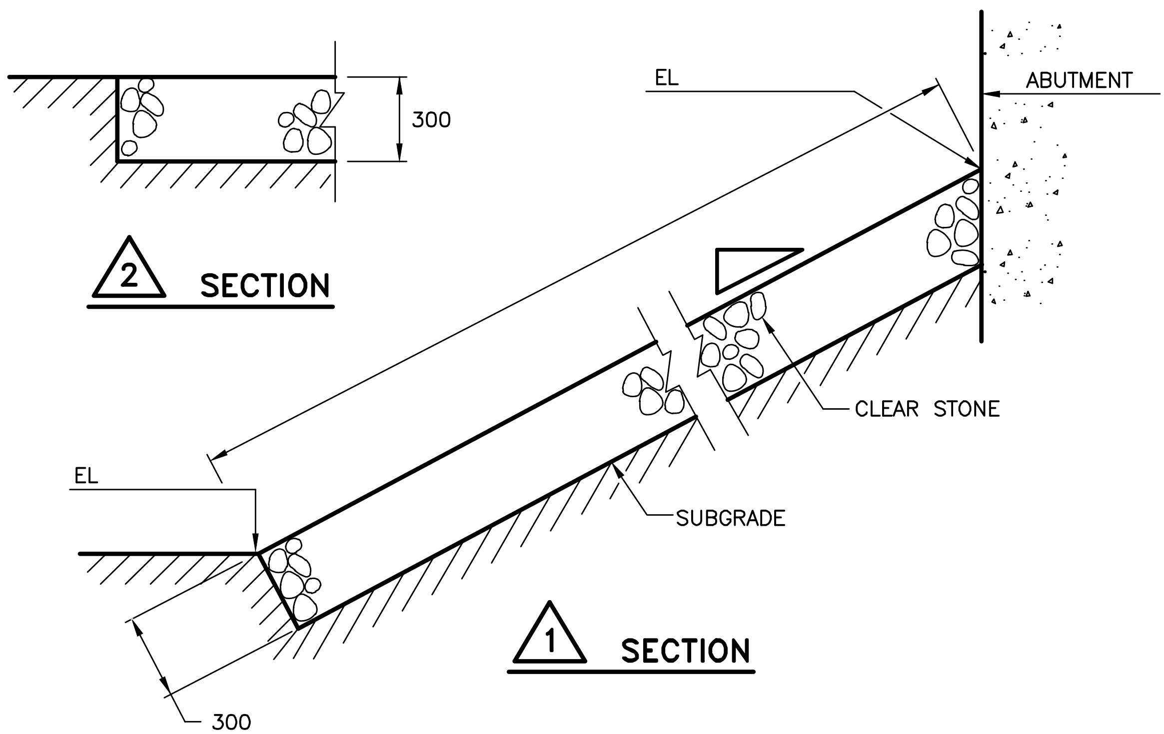
NOTES:

1. All dimensions are in millimetres or metres unless otherwise shown.

ROCK SLOPE PROTECTION WITH BERM	Date	March 1997	Rev	
	SS16-20			



SLOPE PROTECTION LAYOUTS



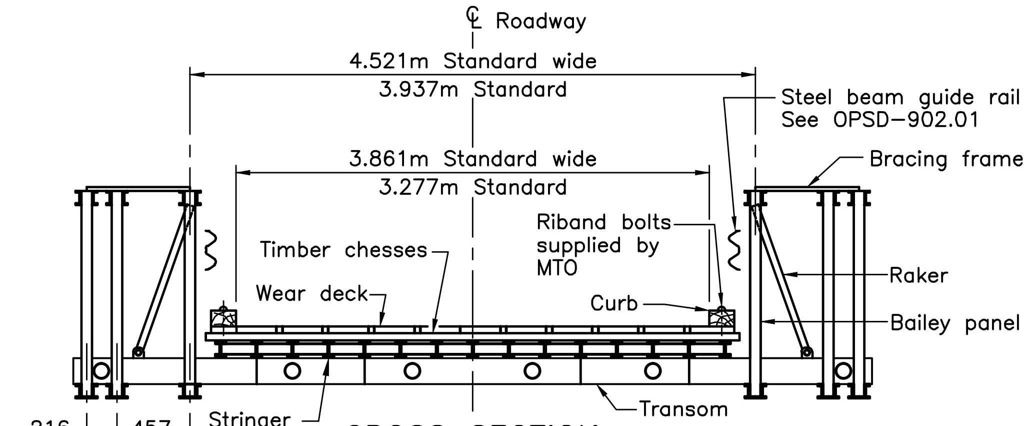
2 SECTION

1 SECTION

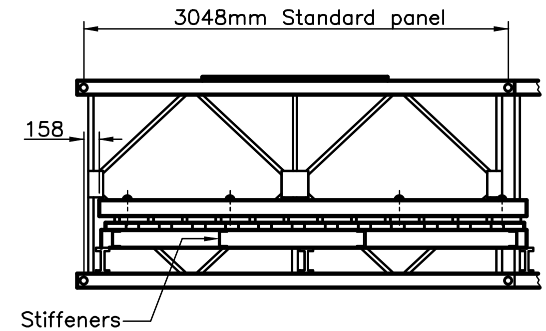
NOTES:

1. All dimensions are in millimetres or metres unless otherwise shown.

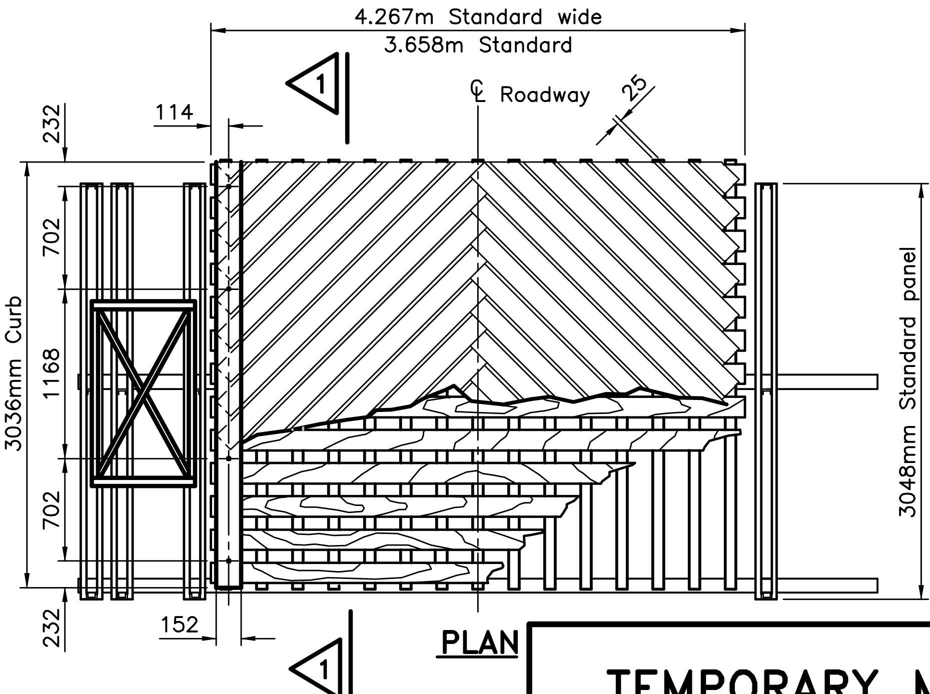
ROCK SLOPE PROTECTION WITHOUT BERM	Date	March 1997	Rev	
	SS16-21			



CROSS SECTION



1 SECTION



PLAN

NOTES:

A. Timber chesses to be jack pine or red pine and consists of:
   - Standard Wide – 38x140mm x 4.267m
   - Standard – 38x140mm x 3.658m

B. Wear deck to be jack pine or red pine and consists of:
   - Standard Wide – 38x140mm x 2.845m
   - Standard – 38x140mm x 2.438m

   Deck to be spiked with 125mm galvanized ardox nails driven on a batter.

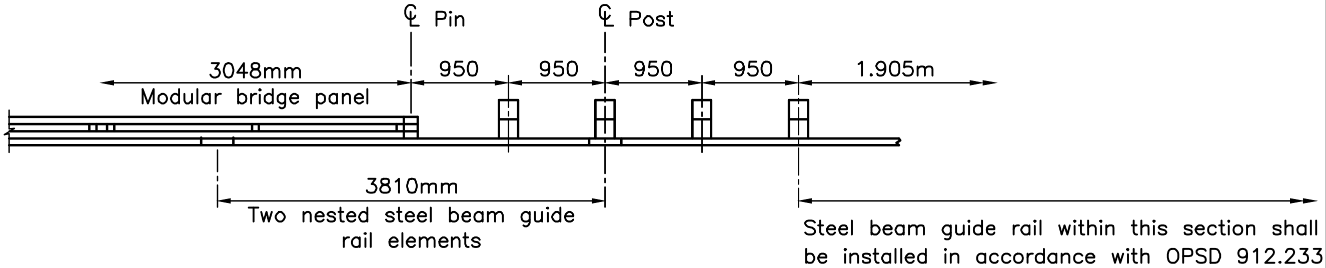
C. Curbs: 152x102mm x 3.036m with bolt holes 25mm dia. to be drilled by the Contractor.

D. All dimensions are in millimetres or metres unless otherwise shown.

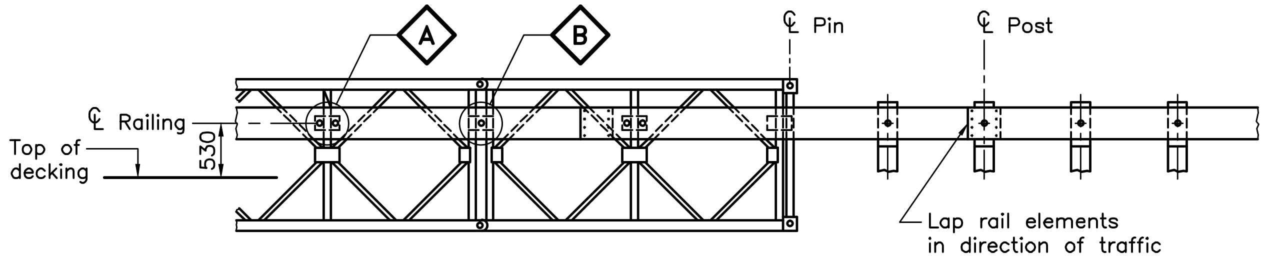
TEMPORARY MODULAR BRIDGE TIMBER DECKING FOR STANDARD AND STANDARD WIDE BRIDGES

Date	March 1997	Rev	

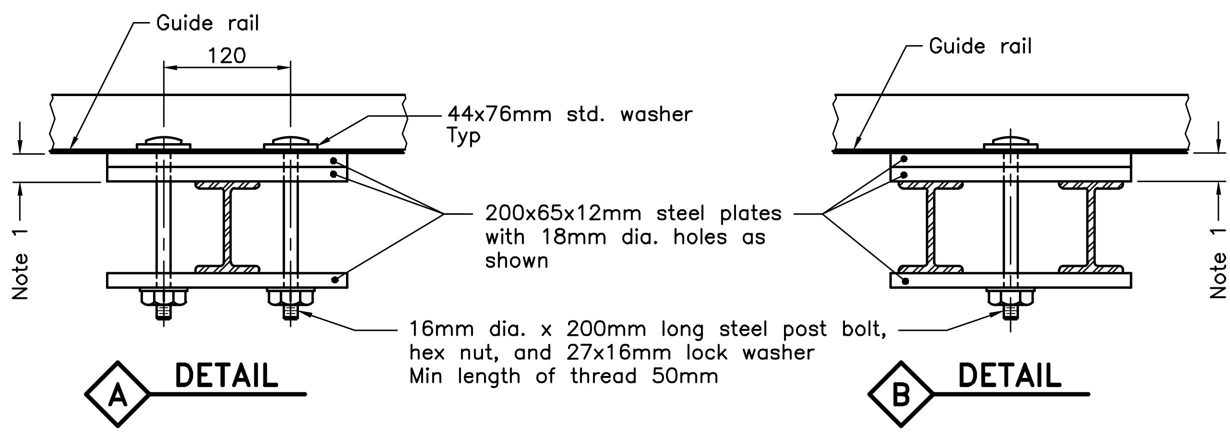
SS16-40



PLAN



FRONT ELEVATION



NOTES:

1. An alternate hollow structural section, timber or other suitable spacer, bearing uniformly on the vertical leg of the bridge panel, may be used provided sufficient horizontal clearance for traffic is maintained. Where bridges have end panels with end posts, the spacer shall have adequate depth to ensure a smooth guide rail alignment.

A. This standard to be used in conjunction with OPSD 912.101.
B. Provide 23x29mm slotted holes in guide rail to suit details A and B.
C. For details of posts, offset blocks, bolts, and washers see OPSD 912.140.
D. Alternate details shall be subject to approval by the Contract Administrator.
E. All connection elements, including steel post bolts, nuts, and washers shall be hot dip galvanized.
F. All dimensions are in millimetres or metres unless otherwise shown.

STEEL BEAM GUIDE RAIL FOR TEMPORARY MODULAR BRIDGES	Date	July 2014	Rev	
	SS16-41			

STRUCTURAL MANUAL

DIVISION 4 – STRUCTURAL STANDARD DRAWINGS
SECTION 2

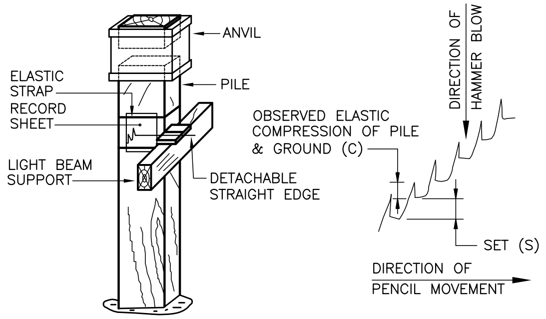
September, 2016

STANDARD DRAWINGS – FULL SIZE DRAWINGS

The following standard drawings are issued in 914 x 610mm format, for use as full-size contract drawings. They require additional information before they can be included in the contract documents.

Digital file names are established by removing one "S" from the Standard Drawing name prefix, and adding the extension "DWG". The drawing files are in AutoCAD.

The layer named UPDATE, in the digital file, contains a Revision Information Sheet for the current revision of the drawing.



FIELD MEASUREMENT TECHNIQUE DURING PILE DRIVING

HAMMERS*		
TYPE	MASS OF RAM W (Kilograms)	RATED ENERGY E (Joules/blow)
9B3	726	12419
10B3	1361	16948
50C	2268	20337
11B3	2268	26005
D12	1250	30506
B225	1360	39300
LB520	2300	40675
B300	1700	46100
D22	2200	53826
B400	2268	62400
D22−02	2200	67000
D22−13	2200	67000
D30−02	3000	91000
D30−13	3000	91000
B500	3129	107100
D36−02	3600	115000
D36−13	3600	115000

NOTE:

Ram may also be referred to as Piston

* See General Notes 5) and 6).

METHOD OF APPLYING THE HILEY FORMULA

The Hiley Formula for:

(a) Double−acting, differential−acting Steam and Diesel Hammers,

$$R = \frac{n\ e_f\ E}{S + C/2} \qquad e_f = 0.6 \text{ to } 0.8 \text{ for steam hammers}, \quad e_f = 1.0 \text{ for diesel hammers}$$

(b) Drop Hammers and single−acting Steam Hammers,

$$R = \frac{n\ e_f\ WgH}{S + C/2} \qquad e_f = 0.75 \text{ for drop hammers}, \quad H = \text{height of free fall of mass in metres}$$

Where
- R = Ultimate pile resistance in kilonewtons
- S = Measured penetration of pile per hammer blow in millimetres
- C = Measured rebound of pile per hammer blow in millimetres
- E = Rated Energy of hammer blow in joules
- e_f = efficiency based on manufacturer's gross rated energy (typ. 0.6 to 0.8)
- n = efficiency of blow
- e = coefficient of restitution
- g = 9.80665 m/s^2
- $n = \frac{W + Pe^2}{W + P}$

where e = 0.32 for steel (or e = 0.55. See Note 1 below.)
= 0.25 for timber
P = Mass of pile + anvil or helmet in kilograms (See Note 2 below)
W = Mass of ram (piston) in kilograms

NOTE 1:

It is assumed that piles are driven with a pile cushion. Where Steel H−Piles are driven without a cushion, the ultimate pile capacity R should be calculated assuming a coefficient of Restitution e = 0.55.

NOTE 2:

Assume mass of anvil = 600 kg unless otherwise noted.

NOTE 3:

The resulting Ultimate Pile Resistance, R, as calculated by Hiley Formula must exceed the Ultimate Geotechnical Resistance given in the Pile Driving Notes on the Contract Drawings.

EXAMPLE FOR DIESEL HAMMERS

Given: Pile HP 310x110, length = 50m
Mass of anvil = 600 kg
Pile driven without a cushion
Hammer is Delmag D22−13
From the Pile Driving Notes on the Contract Drawings,
Ultimate Geotechnical Resistance = 3000 kN

Observations: measured penetration = S = 5mm
measured rebound = C = 10mm

Hiley Formula Calculations

P = 50(110) + 600 = 6100 kg

W = 2200 kg   e = 0.55

$$n = \frac{W + Pe^2}{W + P} = \frac{2200 + 6100\ (0.55)^2}{2200 + 6100} = 0.49$$

E = 67,000 Joules/blow

$$R = \frac{n\ e_f\ E}{S + C/2} = \frac{0.49\ (1.0)\ (67{,}000)}{5 + (10/2)} = \underline{3283\ kN} > 3000\ kN \quad O.K.$$

EXAMPLE FOR DROP HAMMERS

Given: Timber Pile: length = 15m, density = 641 kg/m^3
butt dia. = 0.36m, tip dia. = 0.20m
Mass of Helmet = 300 kg
Mass of Hammer = 2268 kg = W
Fall of Hammer = 1.0 metre = H
e = 0.25
From Pile Driving Notes on Contract Drawings,
Ultimate Geotechnical Resistance = 750 kN

Observations: measured penetration = S = 5mm
measured rebound = C = 20mm

Hiley Formula Calculations

$$P = \left(15 \times \frac{\pi}{4}\left(\frac{0.36 + 0.20}{2}\right)^2 \times 641\right) + 300 = 892\ kg$$

e_f = 0.75

W = 2268 kg

$$n = \frac{W + Pe^2}{W + P} = \frac{2268 + 892(0.25)^2}{2268 + 892} = 0.74$$

$$R = \frac{n\ e_f\ WgH}{S + C/2} = \frac{0.74(0.75)(2268)(9.806)(1.0)}{5 + (20/2)} = \underline{823\ kN} > 750\ kN \quad O.K.$$

NOTES TO DESIGNER

1. WHEN USING THIS STANDARD THE DESIGNER SHOULD ENSURE THAT THE ULTIMATE GEOTECHNICAL RESISTANCE IS GIVEN ON THE CONTRACT DRAWINGS AS DETAILED IN SECTION 3.3.2/3 OF THE STRUCTURAL MANUAL.
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

PILE DRIVING CONTROL

NOTES:

1. THIS STANDARD DRAWING IS FOR THE CONTROL OF PILE INSTALLATIONS BY VALIDATING DESIGN ASSUMPTIONS.
2. THE HILEY FORMULA SHALL BE USED TO CONFIRM PILE RESISTANCE FOR FRICTION−TYPE PILES IN NON−COHESIVE SOILS. FOR USE IN COHESIVE SOILS, THE GEOTECHNICAL ENGINEER WILL HAVE TO BE CONSULTED.
3. DURING PILE DRIVING, THE HAMMER HAS TO REBOUND ENOUGH TO MAINTAIN ITS ENERGY PER BLOW. ACCORDINGLY, THE SOIL MUST PROVIDE SUFFICIENT REBOUND FOR THE HILEY FORMULA TO BE EFFECTIVE.
4. IF THE ULTIMATE PILE RESISTANCE, AS CALCULATED BY THE HILEY FORMULA, IS NOT REACHED WHEN REFERENCED TO A PRESCRIBED PILE TIP ELEVATION OR RANGE OF ELEVATIONS, THE ADVICE AND RECOMMENDATIONS OF A GEOTECHNICAL ENGINEER SHALL BE SOUGHT.
5. THE CONTRACTOR SHALL SUBMIT THE PERTINENT HAMMER PROPERTIES, AS REQUIRED BY OPSS 903.
6. THE TABLE OF HAMMERS GIVEN ON THIS STANDARD DRAWING CAN BE USED FOR COMPARING THE SUBMITTED HAMMER PROPERTIES. IT IS APPROXIMATE AND MAY NOT INCLUDE ALL HAMMERS. THE CONTRACTOR SHALL CONTACT THE MANUFACTURER FOR RATED AND ACTUAL HAMMER ENERGIES.
7. WHEN APPLYING THE HILEY FORMULA, THE HAMMER SHALL BE OPERATED AT FULL CAPACITY.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING APRIL 2008 | SS103−11

PILE DRIVING CONTROL

REVISIONS | DESCRIPTION

DESIGN | CHK | CODE CHBDC−00 | CL 625−ONT | DATE
DRAWN | CHK | SITE | | DWG

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

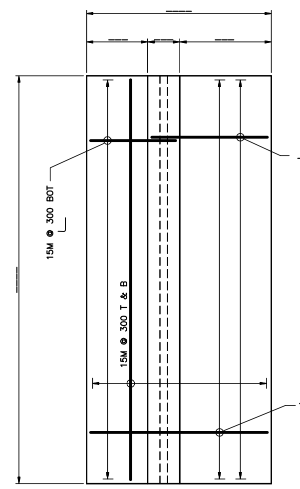
CONT No
WP No

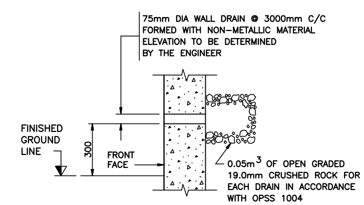
SHEET

RETAINING WALL DETAILS

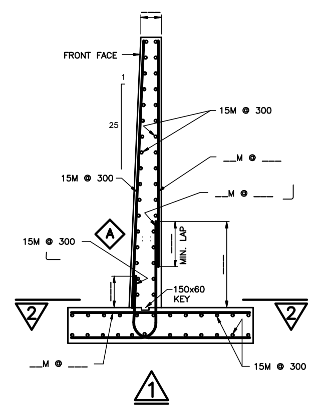
NOTES:

1 CLASS OF CONCRETE TO BE 30 MPa
2 CLEAR COVER TO REINFORCING STEEL:
BOTTOM OF FOOTING: 100 ± 25
REMAINDER: 70 ± 20 UNLESS OTHERWISE NOTED
3 REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
F.F. DENOTES FRONT FACE
B.F. DENOTES BACK FACE
E.F. DENOTES EACH FACE
T DENOTES TOP FACE
B DENOTES BOTTOM FACE

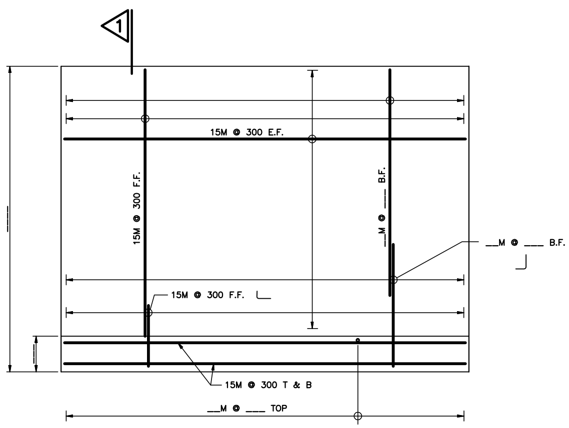




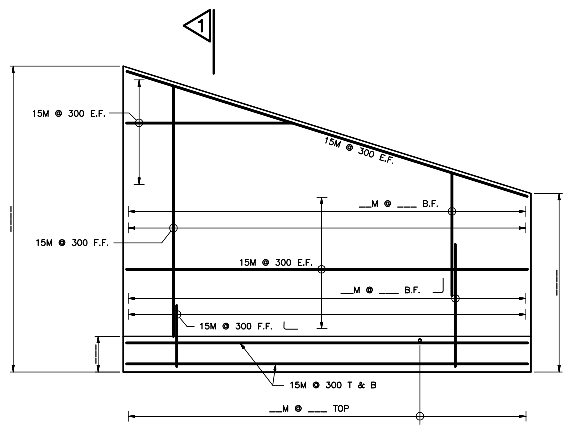
A DETAIL



1



RETAINING WALL ELEVATION



RETAINING WALL ELEVATION (SLOPING)

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING JAN 2013	SS105-1
RETAINING WALL DETAILS	

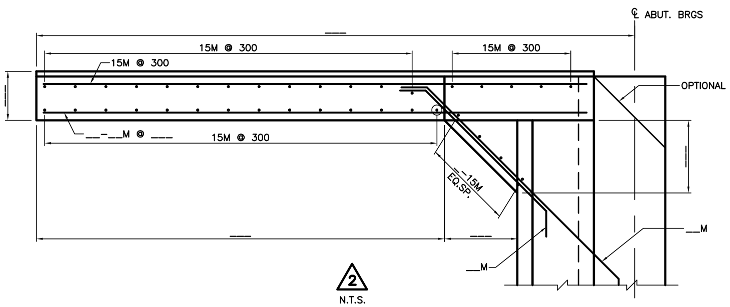
REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

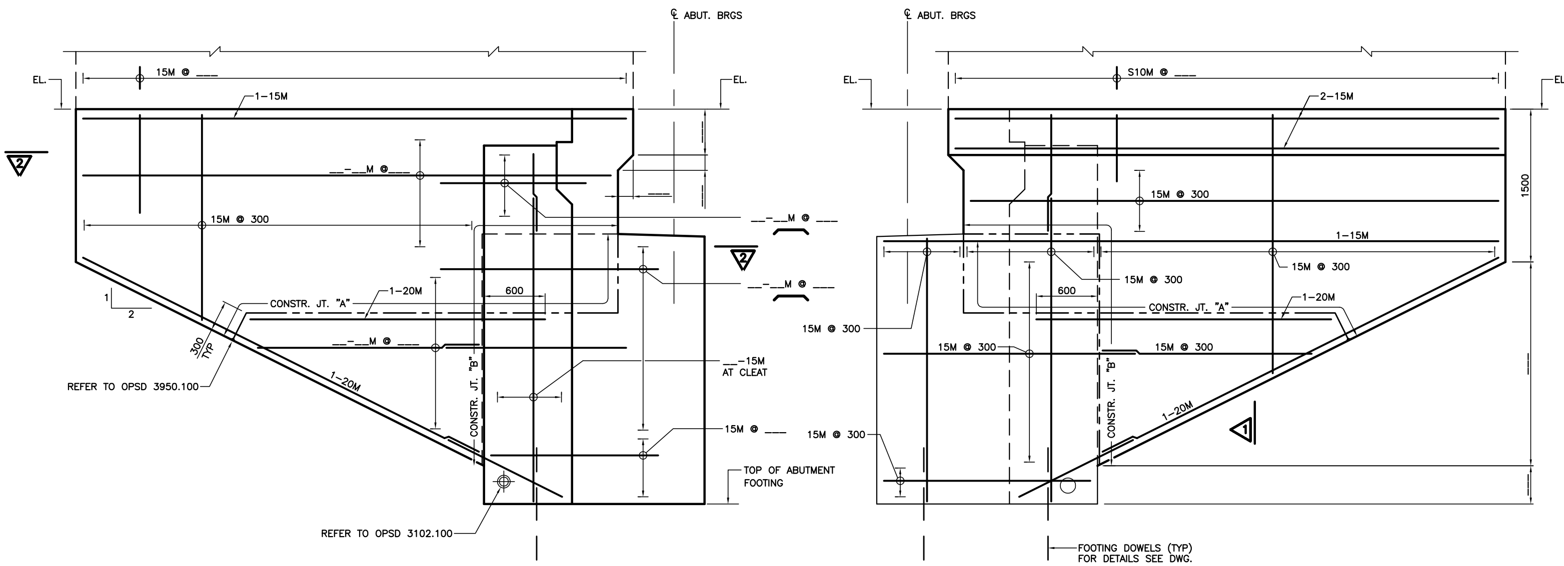
SHEET

WINGWALL DETAILS FOR BRIDGES



2
N.T.S.

DIMENSIONS AND REINFORCEMENT



INSIDE FACE
N.T.S.

OUTSIDE FACE
N.T.S.

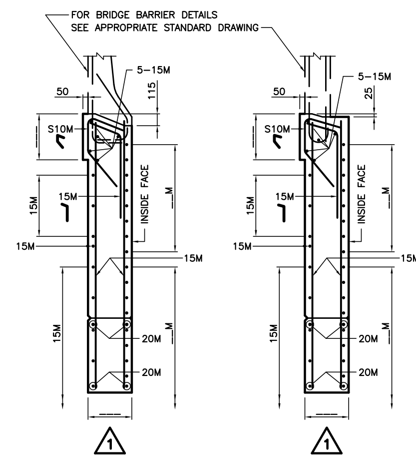
WINGWALL ELEVATIONS
DIMENSIONS AND REINFORCEMENT

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ABUTMENT AND BARRIER/PARAPET WALL DRAWINGS.
2. TOP OF CLEAT TO BE CAST 35mm BELOW APPROACH SLAB LEDGE.
3. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
4. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA. BARS MARKED WITH PREFIX 'S' DENOTE STAINLESS STEEL.

NOTE TO DESIGNER

1. FOR RIGID FRAME AND INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. CONSTRUCTION JOINTS:
   "A" REFERS TO POST-TENSIONED SUPERSTRUCTURES
   "B" REFERS TO SLAB-ON-GIRDER SUPERSTRUCTURES



APPLICABLE STANDARD DRAWINGS

OPSD 3102.100 WALLS ABUTMENT BACKFILL DRAIN
OPSD 3950.100 JOINTS CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE

STANDARD DRAWING JAN 2013	SS105-2
WINGWALL DETAILS FOR BRIDGES	

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	4
450mm≤B<750mm	3	6
750mm≤B<1050mm	4	8

CONT No

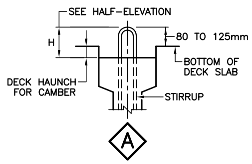
WP No

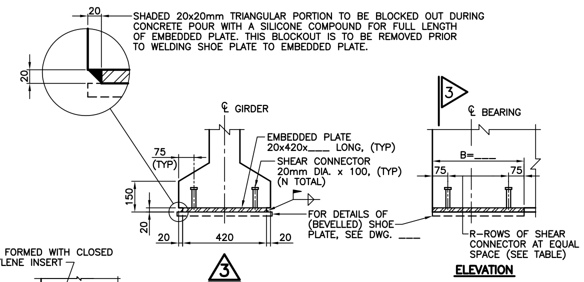
SHEET

PRESTRESSED GIRDERS AND BEARINGS

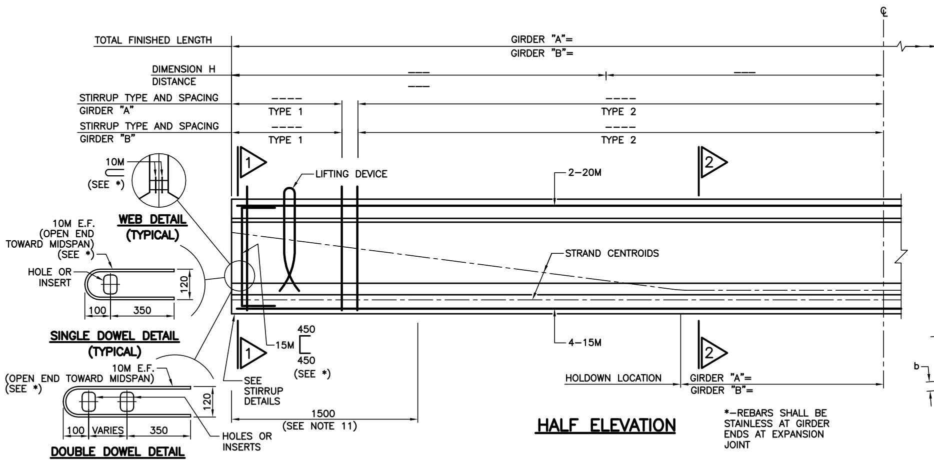
NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND _____ kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BEAM (EXCEPT UNDERCUT) 48 +15mm/−5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/−5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
14. DOWEL INSERTS SHALL BE ZINC PLATED OR GALVANIZED.
15. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20 kN AT SERVICEABILITY LIMIT STATES LOADING.
16. FOR THE DIAPHRAGMS, THE PRECASTER WILL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
17. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
18. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
19. FOR DETAILS OF POSITIVE MOMENT CONNECTION APPLICABLE TO CONTINUOUS GIRDER SEE OPSD 3310.150.
20. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED, THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
21. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.

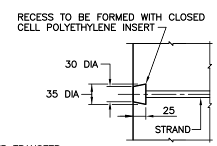




EMBEDDED BEARING ℙ DETAIL

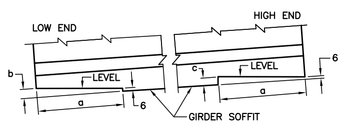


HALF ELEVATION



AFTER TRANSFER:
INSERT TO BE REMOVED AND STRAND TO BE CUT BACK FROM END OF GIRDER USING AN OXYGEN FED HOLLOW STEMMED THERMIC LANCE. RECESS TO BE CLEANED AND FILLED WITH NON-SHRINK GROUT.

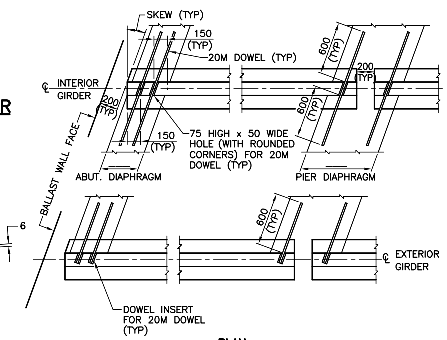
STRAND TREATMENT FOR GIRDER ENDS AT EXPANSION JOINTS



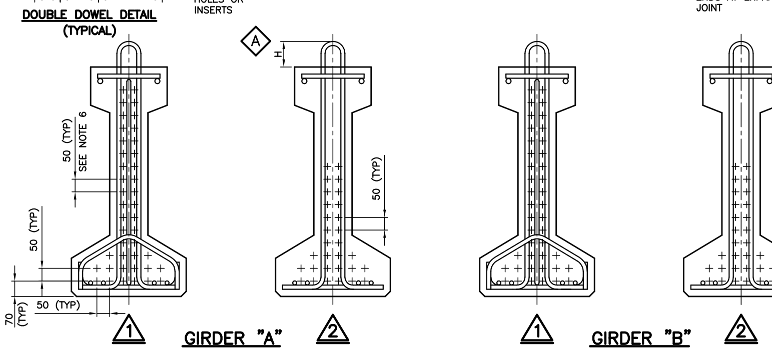
GIRDER TYPE	a	b	c
A	460	___	___
B	460	___	___

GIRDER SOFFIT DETAIL AT BEARINGS

(c = 9, 12, 15 or 18mm)



DIAPHRAGM DETAILS

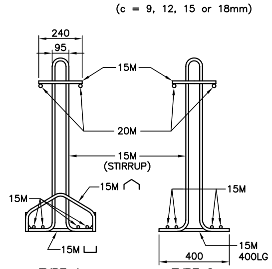


GIRDER "A"

___ STRANDS

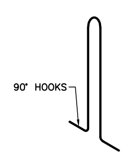
GIRDER "B"

___ STRANDS

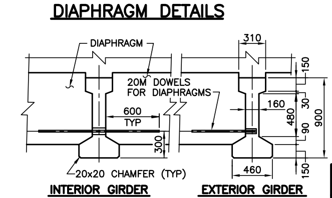


STIRRUP DETAILS

(SEE NOTE 21)



SHAPE OF VERTICAL STIRRUPS



TYPICAL SECTIONS

CPCI 900

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 — **SS107-1**

PRESTRESSED GIRDERS AND BEARINGS (CPCI 900)

REVISIONS					
			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

NOTES TO DESIGNER
1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

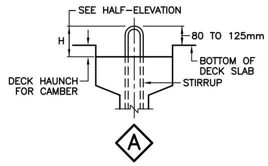
	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

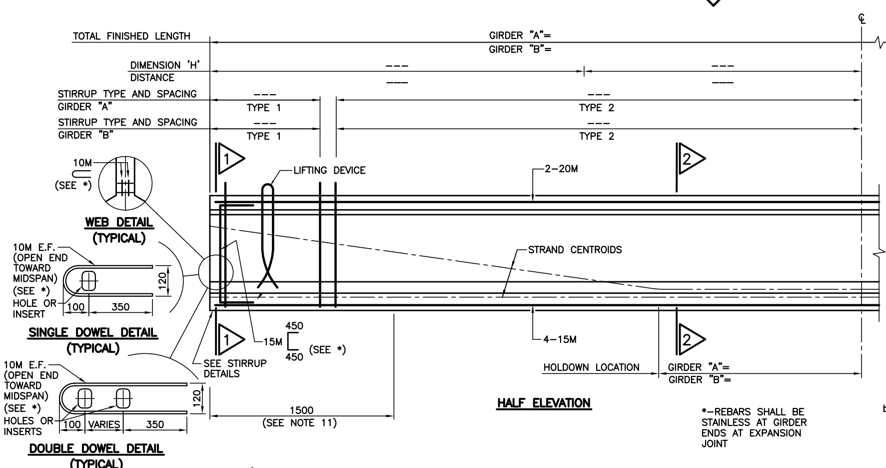
BEARING DATA

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	4
450mm≤B<750mm	3	6
750mm≤B<1050mm	4	8

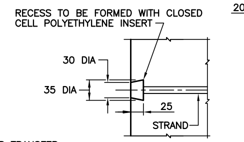
CONT No
WP No
SHEET
PRESTRESSED GIRDERS AND BEARINGS





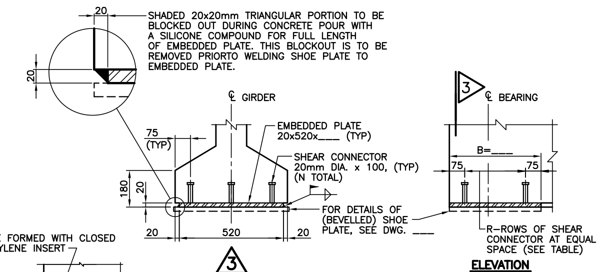
HALF ELEVATION

*-REBARS SHALL BE STAINLESS AT GIRDER ENDS AT EXPANSION JOINT

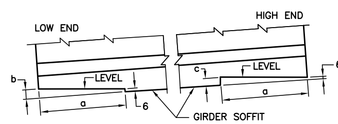


AFTER TRANSFER:
INSERT TO BE REMOVED AND STRAND TO BE CUT BACK FROM END OF GIRDER USING AN OXYGEN FED HOLLOW STEMMED THERMIC LANCE. RECESS TO BE CLEANED AND FILLED WITH NON-SHRINK GROUT.

STRAND TREATMENT FOR GIRDER ENDS AT EXPANSION JOINTS

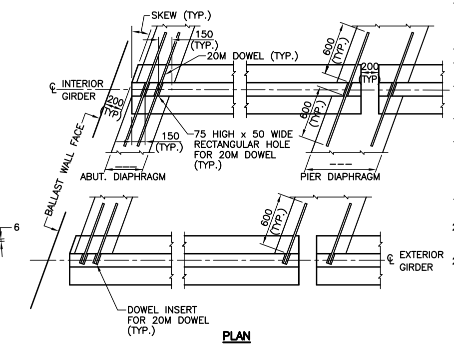


EMBEDDED BEARING ℙ DETAIL



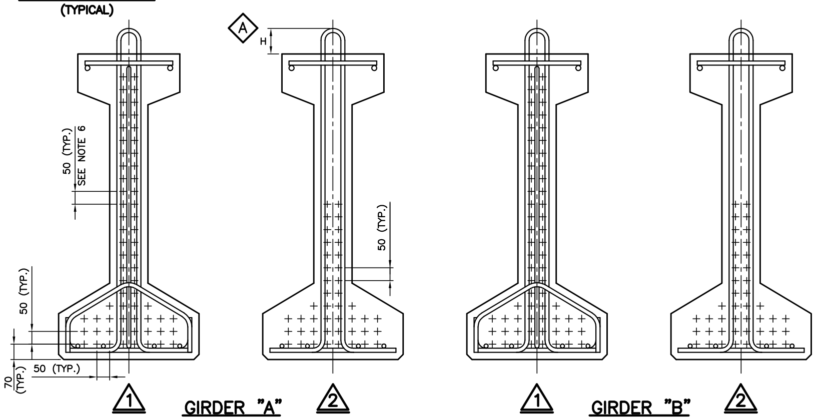
GIRDER TYPE	a	b	c
A	560	___	___
B	560	___	___

GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)



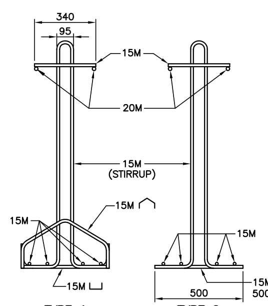
DIAPHRAGM DETAILS

NOTES:
1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION ___, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND _____ kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDER ___ MPa.
   PRECAST GIRDER ___ MPa. (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER ___ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA.
10. CLEAR COVER TO REINFORCING STEEL:
   SOFFIT OF BEAM (EXCEPT UNDERCUT) 48 +15mm/-5mm
   UNDERCUT AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
14. DOWEL INSERTS SHALL BE ZINC PLATED OR GALVANIZED.
15. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20 kN AT SERVICEABILITY LIMIT STATES LOADING.
16. FOR THE DIAPHRAGMS, THE PRECASTER SHALL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
17. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
18. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
19. FOR DETAILS OF POSITIVE MOMENT CONNECTION APPLICABLE TO CONTINUOUS GIRDER SEE OPSD 3310.150.
20. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED, THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
21. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.

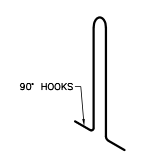


GIRDER "A"
___ STRANDS

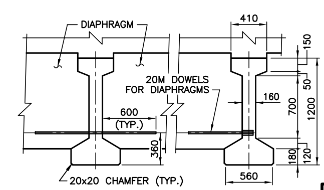
GIRDER "B"
___ STRANDS



STIRRUP DETAILS
(SEE NOTE 21)



SHAPE OF VERTICAL STIRRUPS



INTERIOR GIRDER EXTERIOR GIRDER

TYPICAL SECTIONS

CPCI 1200

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016
SS107-2
PRESTRESSED GIRDERS AND BEARINGS (CPCI 1200)

REVISIONS
DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

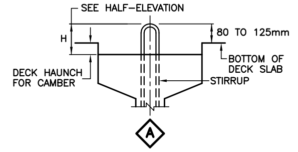
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

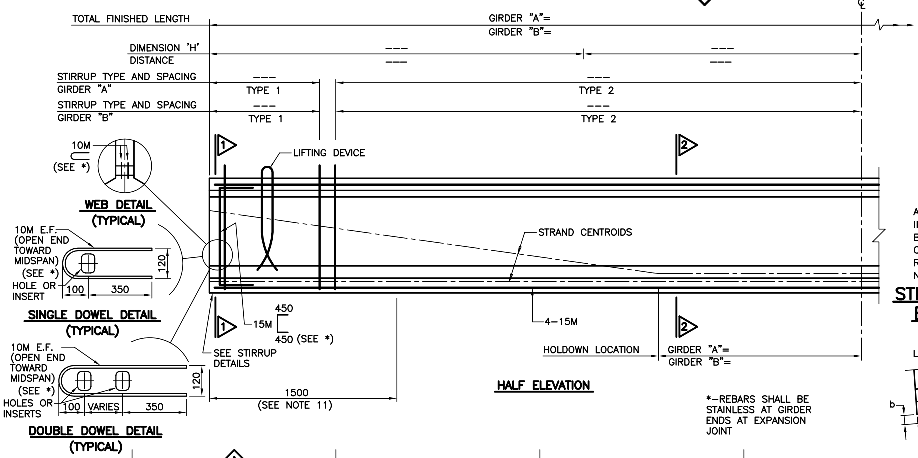
EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	4
450mm≤B<750mm	3	6
750mm≤B<1050mm	4	8

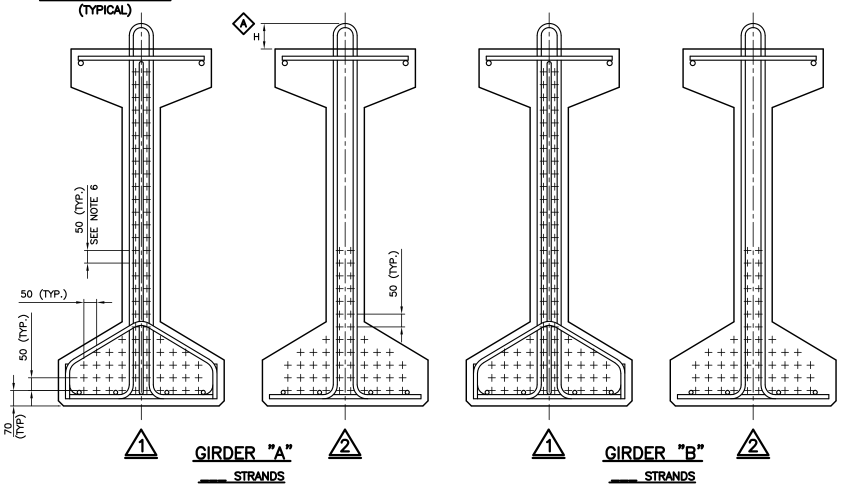
CONT No
WP No

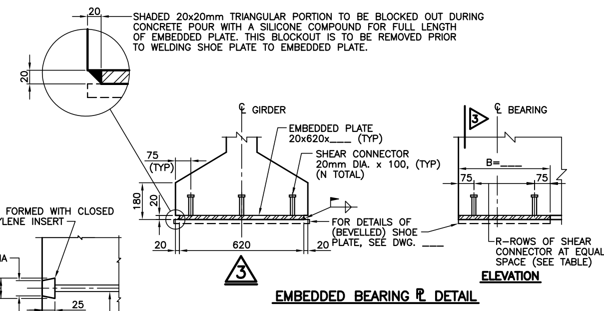
SHEET

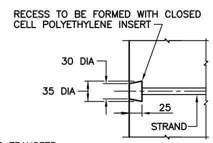
PRESTRESSED GIRDERS AND BEARINGS





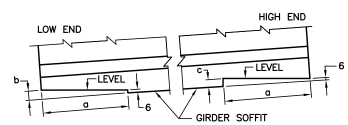






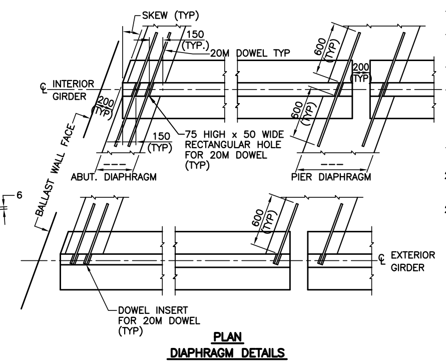
AFTER TRANSFER:
INSERT TO BE REMOVED AND STRAND TO BE CUT BACK FROM END OF GIRDER USING AN OXYGEN FED HOLLOW STEMMED THERMIC LANCE. RECESS TO BE CLEANED AND FILLED WITH NON-SHRINK GROUT.

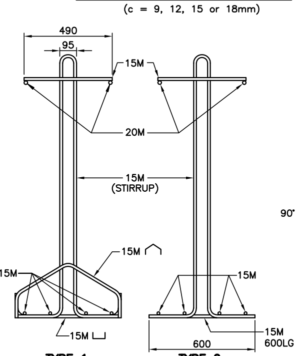
STRAND TREATMENT FOR GIRDER ENDS AT EXPANSION JOINTS



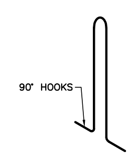
GIRDER TYPE	a	b	c
A	660	___	___
B	660	___	___

GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)

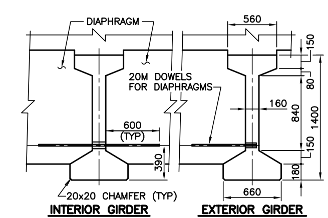




STIRRUP DETAILS
(SEE NOTE 21)



SHAPE OF VERTICAL STIRRUPS



TYPICAL SECTIONS

NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND _____ kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BEAM (EXCEPT UNDERCUT) 48 +15mm/−5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/−5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
14. DOWEL INSERTS SHALL BE ZINC PLATED OR GALVANIZED.
15. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20 kN AT SERVICEABILITY LIMIT STATES LOADING.
16. FOR THE DIAPHRAGMS, THE PRECASTER WILL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
17. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
18. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
19. FOR DETAILS OF POSITIVE MOMENT CONNECTION APPLICABLE TO CONTINUOUS GIRDER SEE OPSD 3310.150.
20. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED, THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
21. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107-3

PRESTRESSED GIRDERS AND BEARINGS (CPCI 1400)

CPCI 1400

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	4
450mm≤B<750mm	3	6
750mm≤B<1050mm	4	8

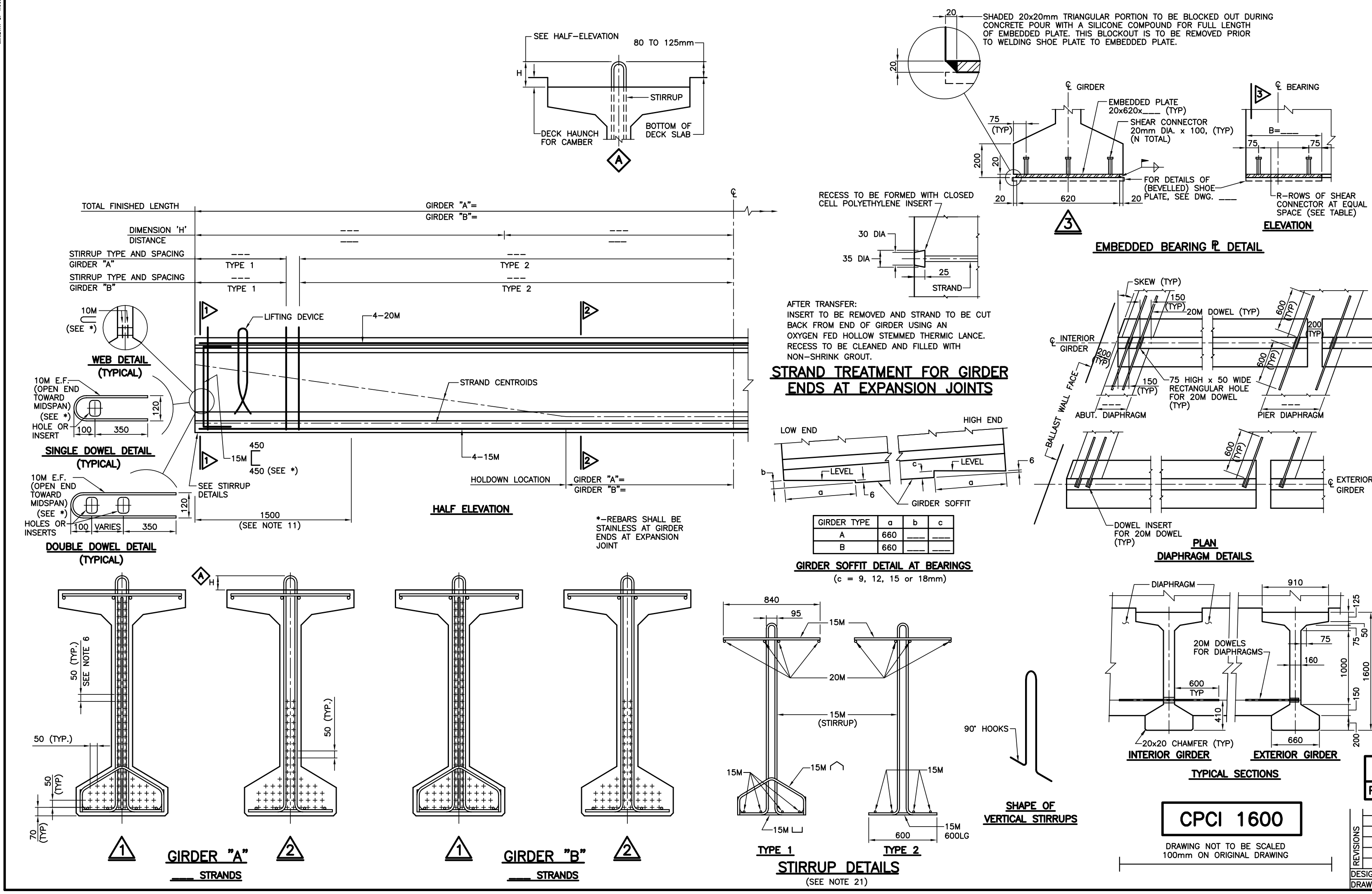
CONT No
WP No

SHEET

PRESTRESSED GIRDERS AND BEARINGS

NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND ____ kN.
3. JACKING FORCE PER STRAND ____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES ____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BEAM (EXCEPT UNDERCUT) 48 +15mm/-5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
14. DOWEL INSERTS SHALL BE ZINC PLATED OR GALVANIZED.
15. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20 kN AT SERVICEABILITY LIMIT STATES LOADING.
16. FOR THE DIAPHRAGMS, THE PRECASTER WILL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
17. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
18. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
19. FOR DETAILS OF POSITIVE MOMENT CONNECTION APPLICABLE TO CONTINUOUS GIRDER SEE OPSD 3310.150.
20. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED, THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
21. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



GIRDER TYPE	a	b	c
A	660	___	___
B	660	___	___

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

CPCI 1600

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
SEPTEMBER 2016

SS107-4

PRESTRESSED GIRDERS AND BEARINGS (CPCI 1600)

REVISIONS				DESCRIPTION
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

METRIC

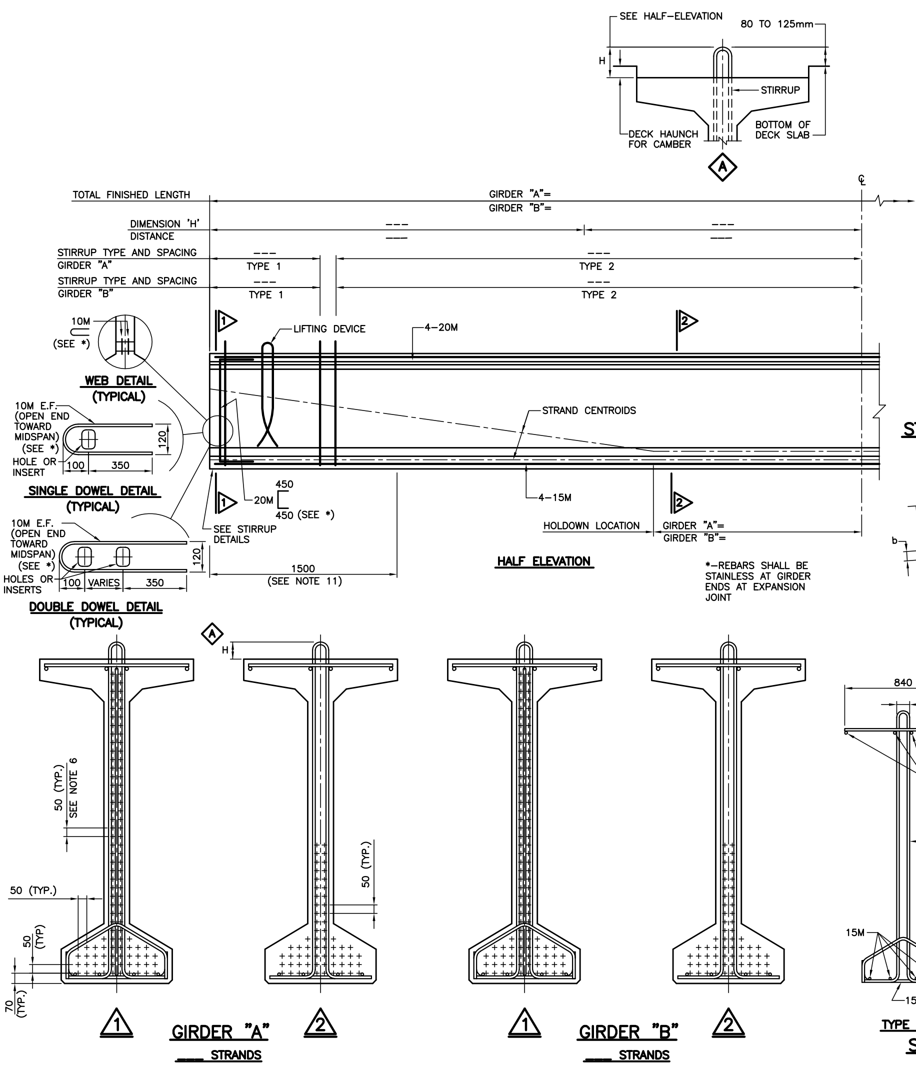
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

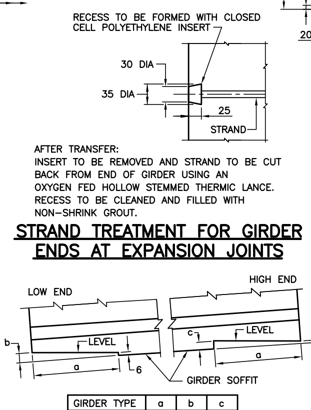
EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	4
450mm≤B<750mm	3	6
750mm≤B<1050mm	4	8

CONT No
WP No

SHEET

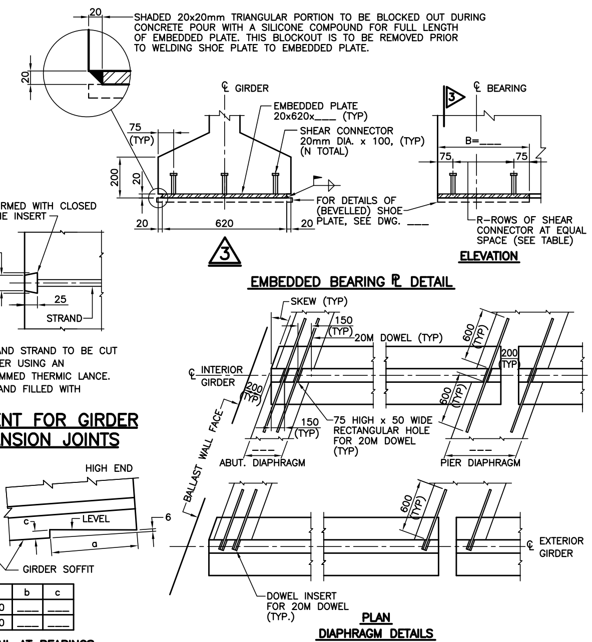
PRESTRESSED GIRDERS AND BEARINGS

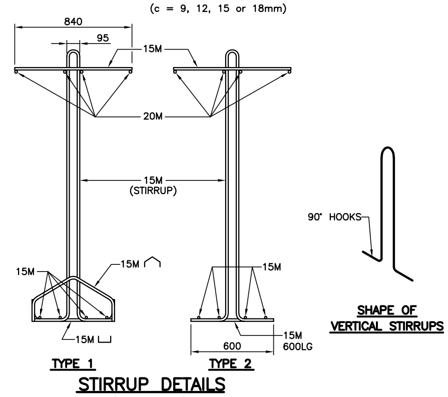


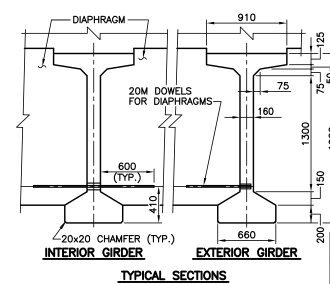


GIRDER TYPE	a	b	c
A	660	___	___
B	660	___	___

GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)







NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION ___, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND _____ kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDER ___ MPa.
   PRECAST GIRDER ___ MPa. (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER ___ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BEAM (EXCEPT UNDERCUT) 48 +15mm/-5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
14. DOWEL INSERTS SHALL BE ZINC PLATED OR GALVANIZED.
15. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20 kN AT SERVICEABILITY LIMIT STATES LOADING.
16. FOR THE DIAPHRAGMS, THE PRECASTER WILL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
17. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
18. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
19. FOR DETAILS OF POSITIVE MOMENT CONNECTION APPLICABLE TO CONTINUOUS GIRDER SEE OPSD 3310.150.
20. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED, THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
21. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107-5

PRESTRESSED GIRDERS AND BEARINGS (CPCI 1900)

CPCI 1900

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS			DESCRIPTION	DATE
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	4
450mm≤B<750mm	3	6
750mm≤B<1050mm	4	8

CONT No

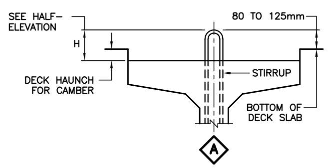
WP No

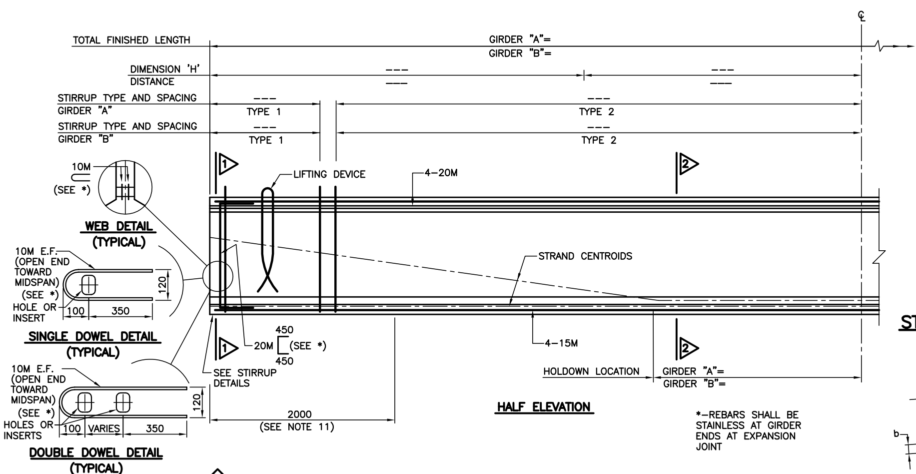
SHEET

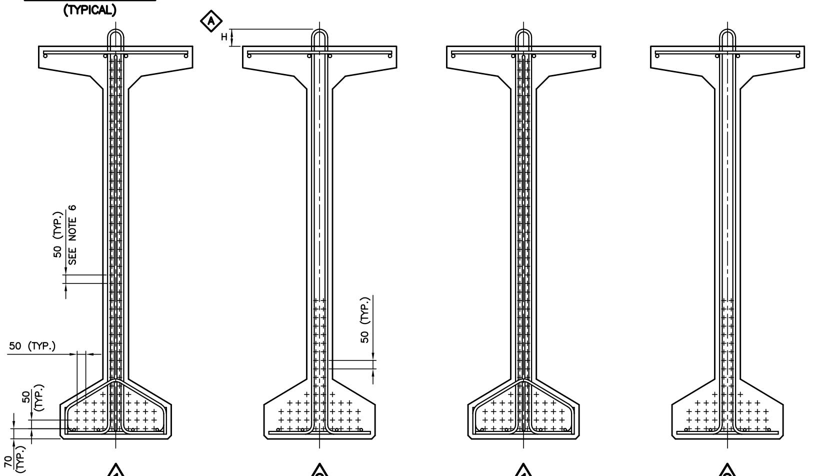
PRESTRESSED GIRDERS AND BEARINGS

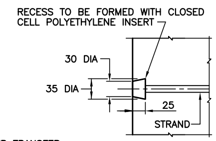
NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND ____ kN.
3. JACKING FORCE PER STRAND ____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES ____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BEAM (EXCEPT UNDERCUT) 48 +15mm/-5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
14. DOWEL INSERTS SHALL BE ZINC PLATED OR GALVANIZED.
15. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20 kN AT SERVICEABILITY LIMIT STATES LOADING.
16. FOR THE DIAPHRAGMS, THE PRECASTER WILL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
17. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
18. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
19. FOR DETAILS OF POSITIVE MOMENT CONNECTION APPLICABLE TO CONTINUOUS GIRDER SEE OPSD 3310.150.
20. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED, THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
21. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



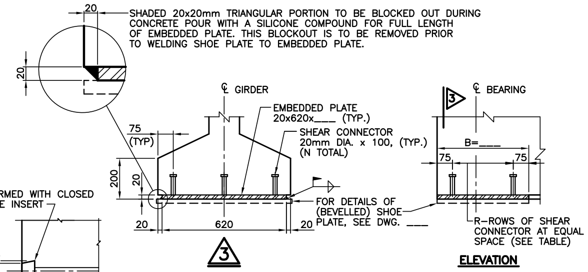




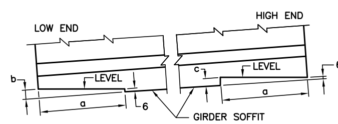


AFTER TRANSFER:
INSERT TO BE REMOVED AND STRAND TO BE CUT BACK FROM END OF GIRDER USING AN OXYGEN FED HOLLOW STEMMED THERMIC LANCE. RECESS TO BE CLEANED AND FILLED WITH NON-SHRINK GROUT.

STRAND TREATMENT FOR GIRDER ENDS AT EXPANSION JOINTS



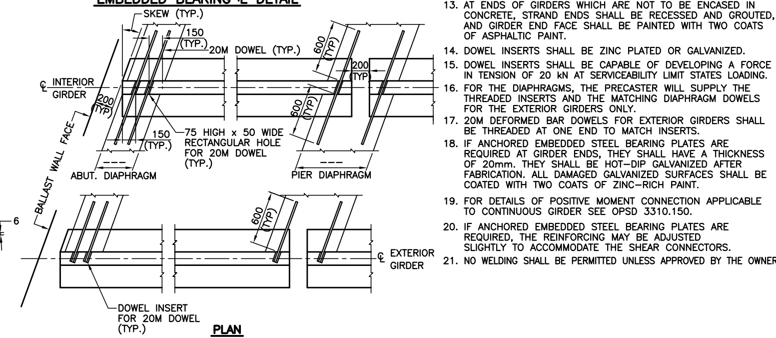
EMBEDDED BEARING ℄ DETAIL



GIRDER TYPE	a	b	c
A	660	___	___
B	660	___	___

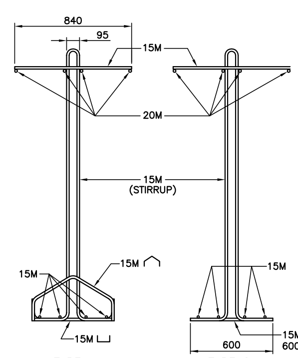
GIRDER SOFFIT DETAIL AT BEARINGS

(c = 9, 12, 15 or 18mm)



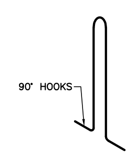
PLAN

DIAPHRAGM DETAILS

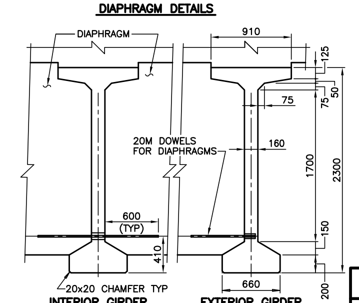


STIRRUP DETAILS

(SEE NOTE 21)



SHAPE OF VERTICAL STIRRUPS



TYPICAL SECTIONS

CPCI 2300

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 **SS107-6**

PRESTRESSED GIRDERS AND BEARINGS (CPCI 2300)

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

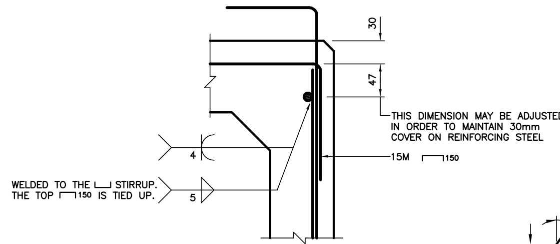
CONT No
WP No

SHEET

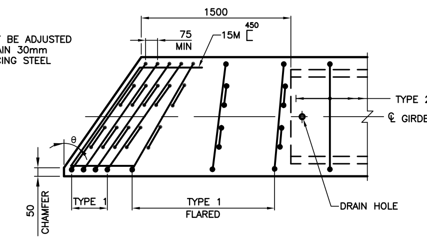
PRESTRESSED BOX GIRDERS AND BEARINGS (B700)

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

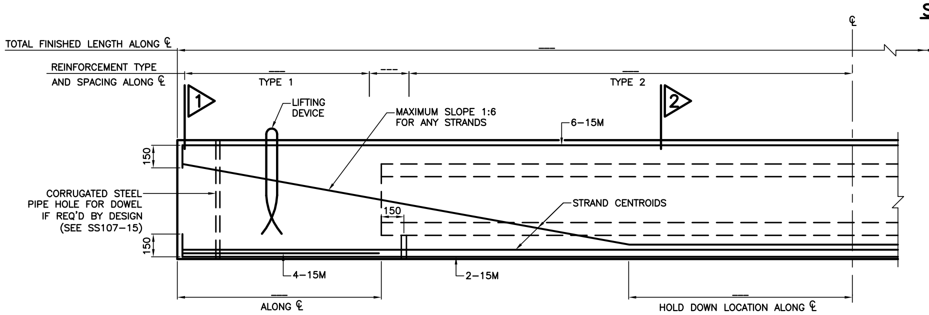
BEARING DATA



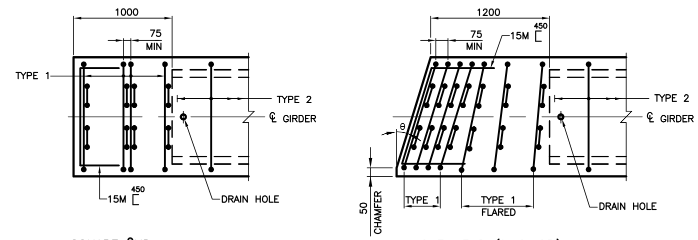
DETAIL B
STRUCTURAL WELD
(WELDED CAGES ONLY)



SKEW END (25°<θ≤45°)



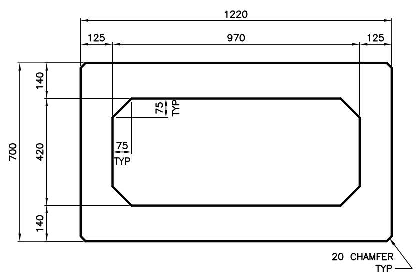
HALF ELEVATION



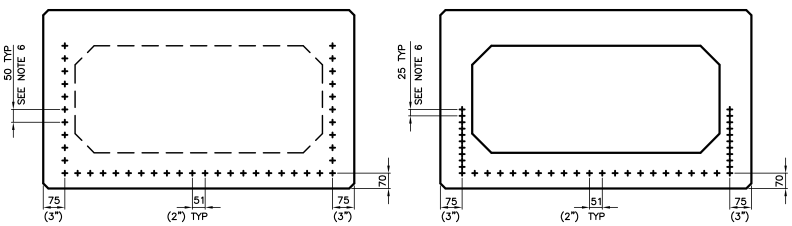
TYPICAL END REINFORCING

NOTES:

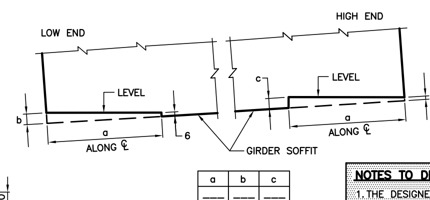
1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND ____ kN.
3. JACKING FORCE PER STRAND ____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES ____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. THE VERTICAL SPACING OF PRESTRESSING STRANDS IN THE WEB BETWEEN LOCATIONS OF HOLD-DOWN POINTS SHOWN ON THIS DRAWING MAY BE INCREASED TO SUIT THE FABRICATOR'S HARDWARE CAPABILITIES TO A MAXIMUM OF 50mm. IF THE SPECIFIED STRAND SPACING IS CHANGED, THE FABRICATOR SHALL BE RESPONSIBLE FOR ADJUSTING THE NUMBER OF STRANDS TO ENSURE THAT THE SAME FORCE EFFECT IS PRODUCED AS REQUIRED BY THE DESIGN.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BOTTOM SLAB (EXCEPT UNDERCUT) 48 +15mm/-5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/-5mm
11. ALL STIRRUPS, DOWELS INTO DECK AND BURSTING/SPLITTING REINFORCEMENT WITHIN 1000mm FROM THE GIRDER END WITH EXPANSION JOINT SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. THE TOP OF PRECAST BEAM SHALL BE GIVEN ROUGH FINISH OF ABOUT 5mm AMPLITUDE ACROSS THE WIDTH.
14. DRAWING TO BE READ IN CONJUNCTION WITH SS107-15.
15. NO WELDING SHALL BE PERMITTED EXCEPT AS SPECIFIED OR APPROVED BY THE OWNER.



TYPICAL SECTION

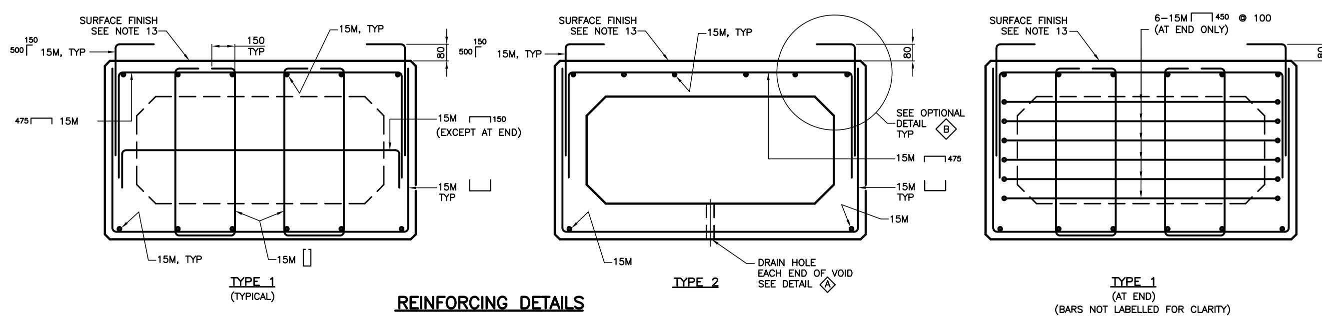


STRAND ARRANGEMENT
___ STRANDS

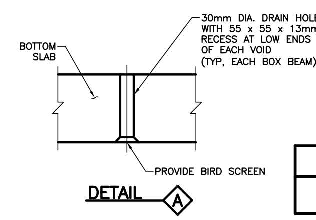


GIRDER SOFFIT DETAIL AT BEARINGS
NOTE: DIMENSIONS b & c = 9, 12, 15 or 18mm, AS REQUIRED BY THE DESIGN.

NOTES TO DESIGNER
1. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
2. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
3. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



REINFORCING DETAILS



DETAIL A

B700

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

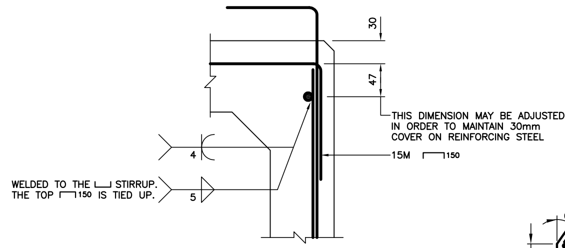
SS107-11

PRESTRESSED BOX GIRDERS AND BEARINGS (B700)

REVISIONS				
DESCRIPTION				
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA



DETAIL B STRUCTURAL WELD

(WELDED CAGES ONLY)

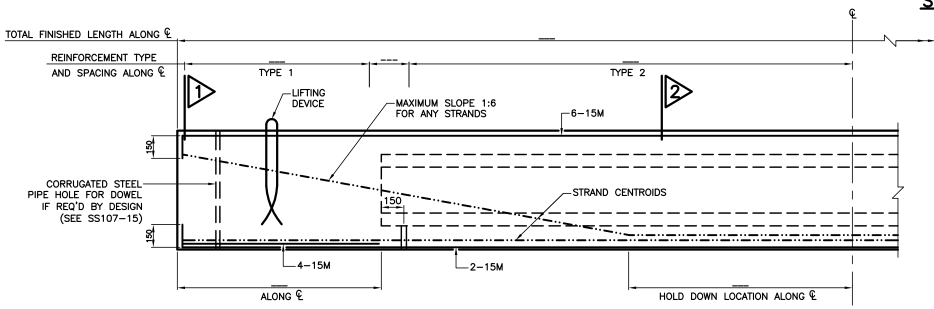
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

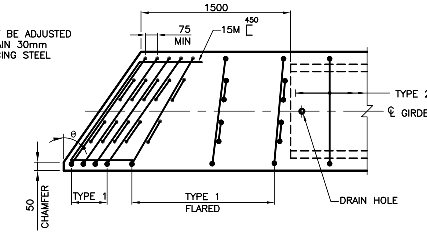
CONT No
WP No

SHEET

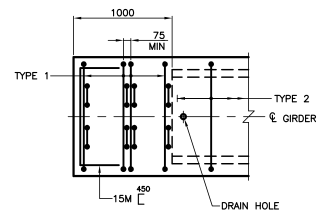
PRESTRESSED BOX GIRDERS AND BEARINGS (B800)



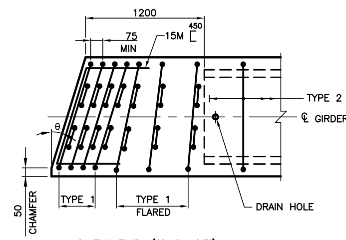
HALF ELEVATION



SKEW END (25°<θ≤45°)



SQUARE END

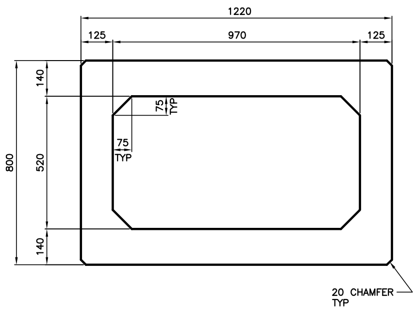


SKEW END (0°<θ≤25°)

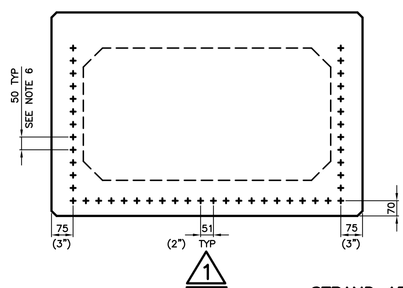
TYPICAL END REINFORCING

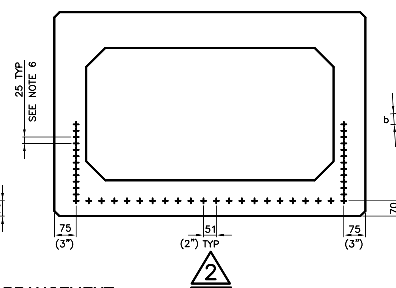
NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION ___, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND _____ kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. THE VERTICAL SPACING OF PRESTRESSING STRANDS IN THE WEB BETWEEN LOCATIONS OF HOLD-DOWN POINTS SHOWN ON THIS DRAWING MAY BE INCREASED TO SUIT THE FABRICATOR'S HARDWARE CAPABILITIES TO A MAXIMUM OF 50mm. IF THE SPECIFIED STRAND SPACING IS CHANGED, THE FABRICATOR SHALL BE RESPONSIBLE FOR ADJUSTING THE NUMBER OF STRANDS TO ENSURE THAT THE SAME FORCE EFFECT IS PRODUCED AS REQUIRED BY THE DESIGN.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BOTTOM SLAB (EXCEPT UNDERCUT) 48 +15mm/−5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/−5mm
11. ALL STIRRUPS, DOWELS INTO DECK AND BURSTING/SPLITTING REINFORCEMENT WITHIN 1000mm FROM THE GIRDER END WITH EXPANSION JOINT SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. THE TOP OF PRECAST BEAM SHALL BE GIVEN ROUGH FINISH OF ABOUT 5mm AMPLITUDE ACROSS THE WIDTH.
14. DRAWING TO BE READ IN CONJUNCTION WITH SS107-15.
15. NO WELDING SHALL BE PERMITTED EXCEPT AS SPECIFIED OR APPROVED BY THE OWNER.



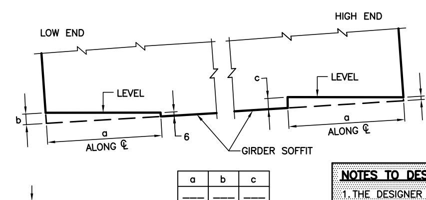
TYPICAL SECTION





STRAND ARRANGEMENT

___ STRANDS



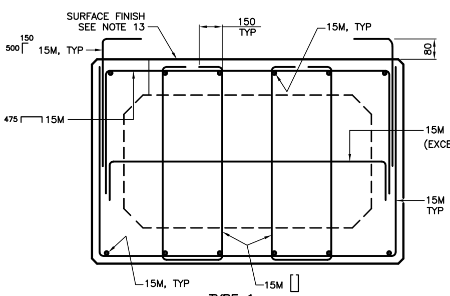
a	b	c
___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS

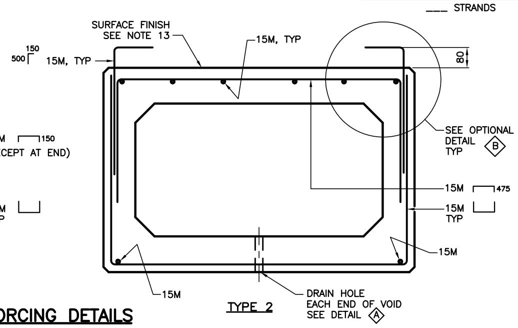
NOTE: DIMENSIONS b AND c = 9, 12, 15 OR 18mm, AS REQUIRED BY THE DESIGN

NOTES TO DESIGNER

1. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
2. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

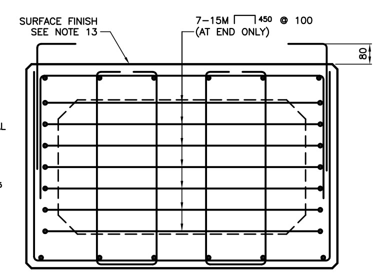


TYPE 1
(TYPICAL)

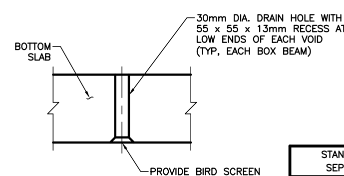


TYPE 2

REINFORCING DETAILS



TYPE 1
(AT END)
(BARS NOT LABELLED FOR CLARITY)



DETAIL A

B800

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107-12

PRESTRESSED BOX GIRDERS AND BEARINGS (B800)

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

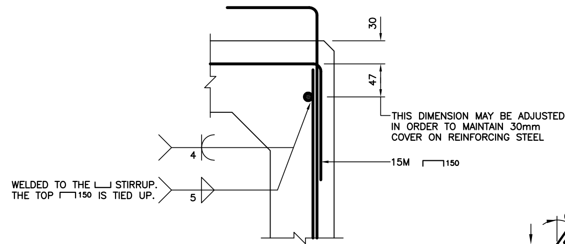
CONT No
WP No

SHEET

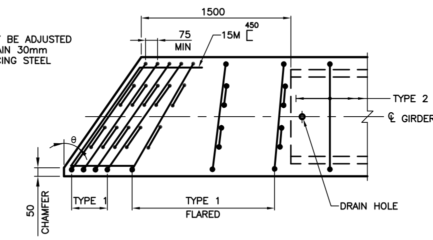
PRESTRESSED BOX GIRDERS AND BEARINGS (B900)

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

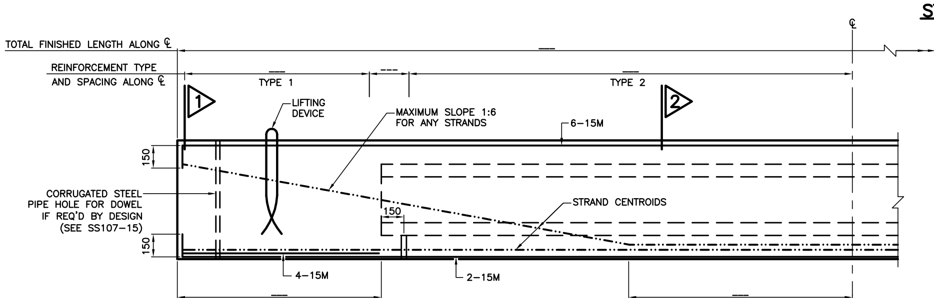
BEARING DATA



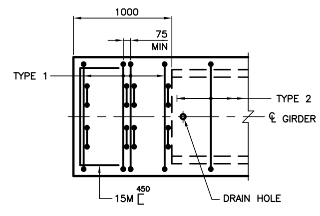
DETAIL B STRUCTURAL WELD
(WELDED CAGES ONLY)



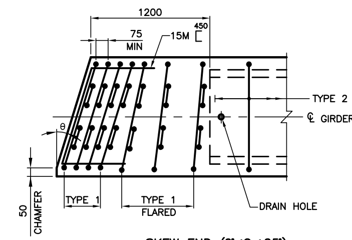
SKEW END (25°<θ≤45°)



HALF ELEVATION



SQUARE END

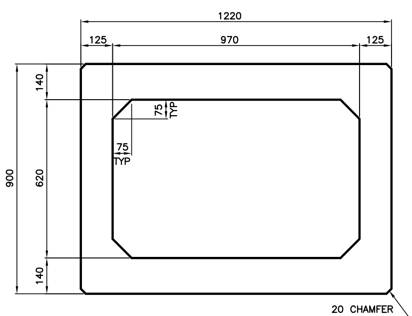


SKEW END (0°<θ≤25°)

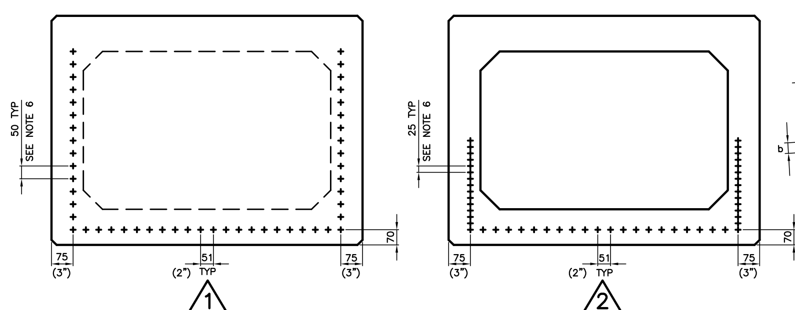
TYPICAL END REINFORCING

NOTES:

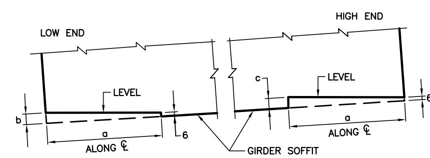
1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND ____ kN.
3. JACKING FORCE PER STRAND ____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES ____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. THE VERTICAL SPACING OF PRESTRESSING STRANDS IN THE WEB BETWEEN LOCATIONS OF HOLD-DOWN POINTS SHOWN ON THIS DRAWING MAY BE INCREASED TO SUIT THE FABRICATOR'S HARDWARE CAPABILITIES TO A MAXIMUM OF 50mm. IF THE SPECIFIED STRAND SPACING IS CHANGED, THE FABRICATOR SHALL BE RESPONSIBLE FOR ADJUSTING THE NUMBER OF STRANDS TO ENSURE THAT THE SAME FORCE EFFECT IS PRODUCED AS REQUIRED BY THE DESIGN.
7. CLASS OF CONCRETE:
   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
8. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL:
    SOFFIT OF BOTTOM SLAB (EXCEPT UNDERCUT) 48 +15mm/-5mm
    UNDERCUT AND ELSEWHERE 30 +15mm/-5mm
11. ALL STIRRUPS, AND BURSTING/SPLITTING REINFORCEMENT WITHIN 1000mm FROM THE GIRDER END WITH EXPANSION JOINT SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. THE TOP OF PRECAST BEAM SHALL BE GIVEN ROUGH FINISH OF ABOUT 5mm AMPLITUDE ACROSS THE WIDTH.
14. DRAWING TO BE READ IN CONJUNCTION WITH SS107-15.
15. NO WELDING SHALL BE PERMITTED EXCEPT AS SPECIFIED OR APPROVED BY THE OWNER.



TYPICAL SECTION



STRAND ARRANGEMENT
___ STRANDS

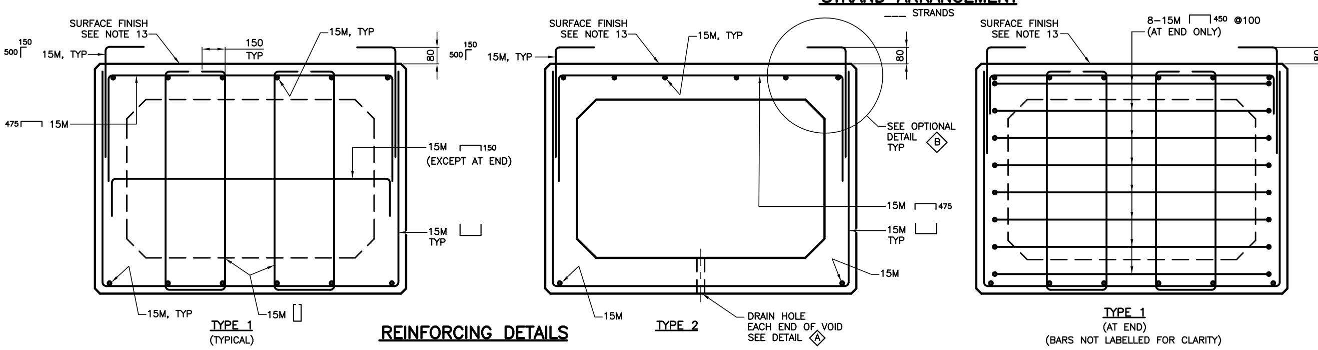


a	b	c
___	___	___

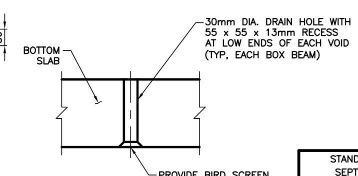
GIRDER SOFFIT DETAIL AT BEARINGS
NOTE: DIMENSIONS b AND c = 9, 12, 15 OR 18mm, AS REQUIRED BY THE DESIGN

NOTES TO DESIGNER

1. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
2. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



REINFORCING DETAILS



DETAIL A

B900

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016	SS107-13
PRESTRESSED BOX GIRDERS AND BEARINGS (B900)	

REVISIONS

DESCRIPTION				
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

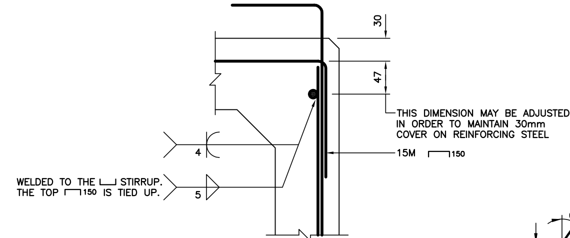
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No	
WP No	SHEET

PRESTRESSED BOX GIRDERS AND BEARINGS (B1000)

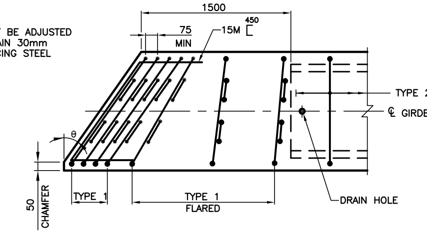
LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

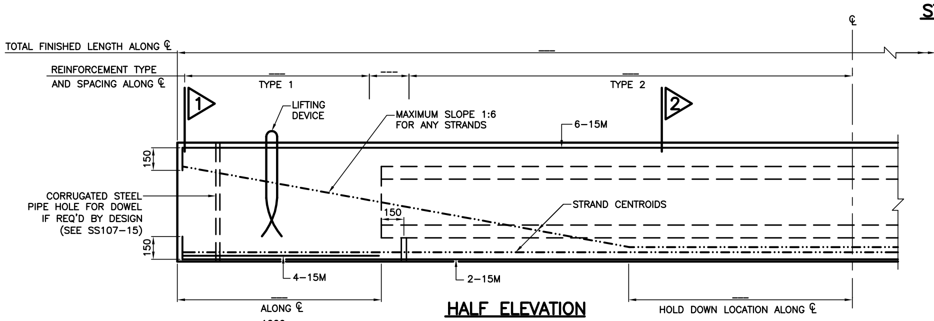


DETAIL B STRUCTURAL WELD

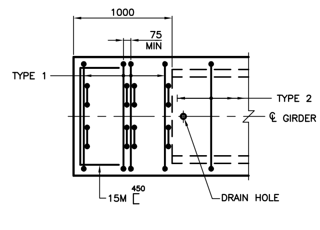
(WELDED CAGES ONLY)



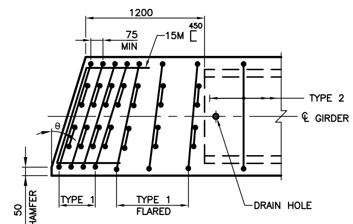
SKEW END (25°<θ≤45°)



HALF ELEVATION



SQUARE END



SKEW END (0°<θ≤25°)

TYPICAL END REINFORCING

NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION __, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND ____ kN.
3. JACKING FORCE PER STRAND ____ kN.
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5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
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   PRECAST GIRDER __ MPa.
   PRECAST GIRDER __ MPa. (CONCRETE CONTAINING SILICA FUME)
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   STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL:
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    UNDERCUT AND ELSEWHERE 30 +15mm/−5mm
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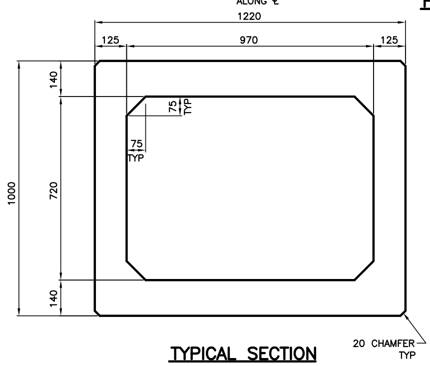
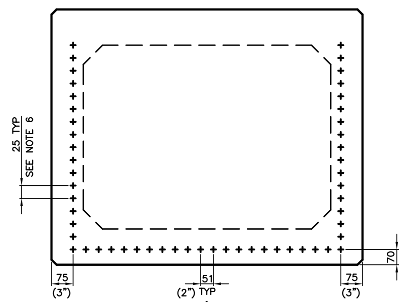
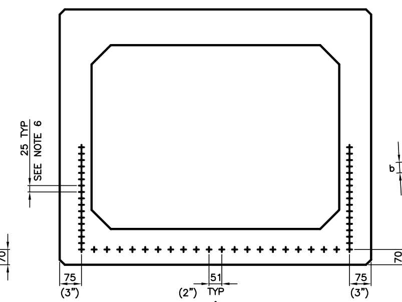
15. NO WELDING SHALL BE PERMITTED EXCEPT AS SPECIFIED OR APPROVED BY THE OWNER.



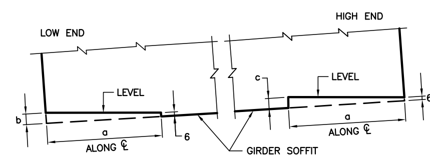
TYPICAL SECTION





STRAND ARRANGEMENT

___ STRANDS



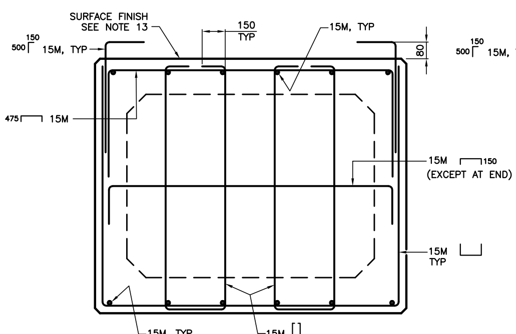
a	b	c
___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS

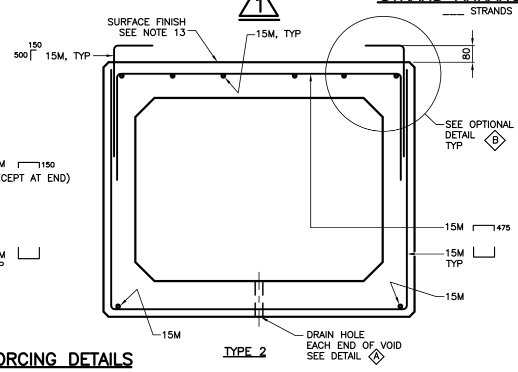
NOTE: DIMENSIONS b AND c = 9, 12, 15 OR 18mm, AS REQUIRED BY THE DESIGN

NOTES TO DESIGNER

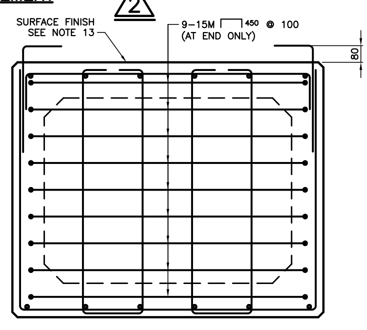
1. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
2. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
3. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



TYPE 1 (TYPICAL)

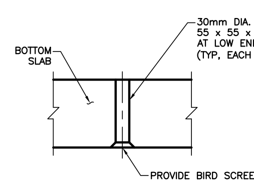


TYPE 2



TYPE 1 (AT END) (BARS NOT LABELLED FOR CLARITY)

REINFORCING DETAILS



A DETAIL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016	SS107-14

PRESTRESSED BOX GIRDERS AND BEARINGS (B1000)

B1000

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

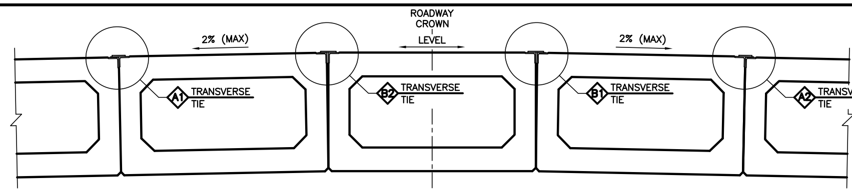
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

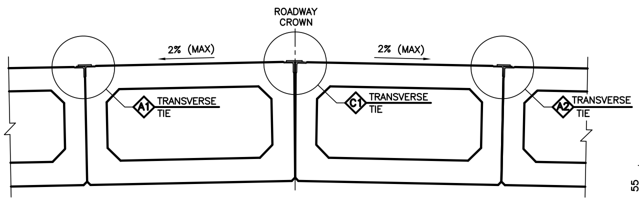
CONT No
WP No

SHEET

PRESTRESSED BOX GIRDERS DETAILS



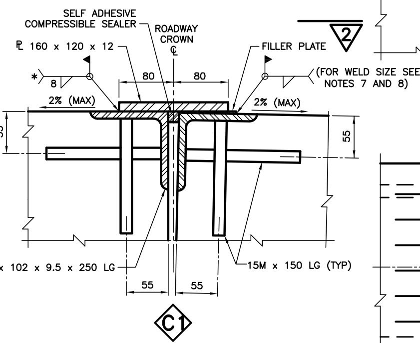
JOINT OFFSET FROM ROADWAY CROWN

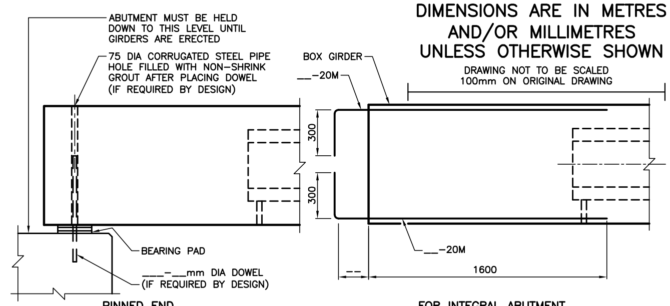


JOINT AT ROADWAY CROWN

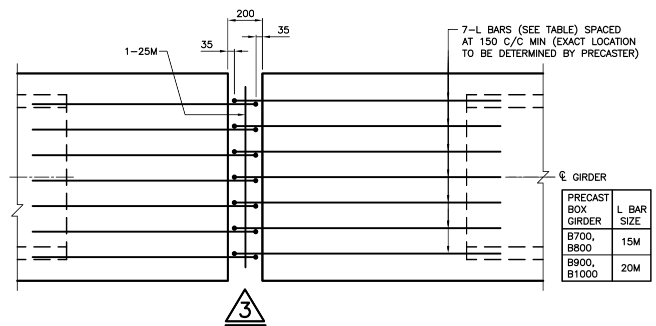
TRANSVERSE TIE LOCATIONS

SPAN LENGTH	TIE LOCATIONS AT 1/4 SPAN	1/3 SPAN	MIDSPAN
≤24M	–	X	–
>24M	X	–	X





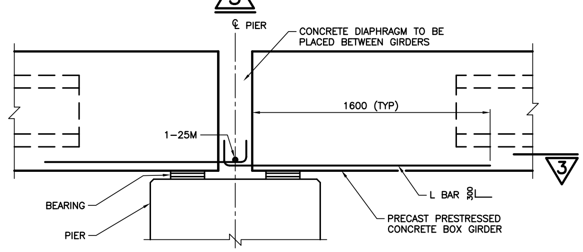
BEAM TO ABUTMENT



PRECAST BOX GIRDER	L BAR SIZE
B700, B800	15M
B900, B1000	20M

NOTES:

1. THIS DRAWING SHOWS TYPICAL DETAILS FOR PRECAST CONCRETE BOX GIRDERS AND IS TO BE READ IN CONJUNCTION WITH DRAWING SS107–__.
2. STEEL PLATES AND ANGLES SHALL BE ACCORDING TO CSA G40.20–13/G40.21–13, GRADE 300W
3. STEEL PLATES AND ANGLES SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION.
4. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDER ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC–RICH PAINT.
5. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
6. STEEL FILLER PLATES SHALL BE PROVIDED WHENEVER THE TOP OF BOX ELEVATIONS, AT THE TRANSVERSE TIE LOCATIONS, DIFFER MORE THAN 2mm.
7. IF THE THICKNESS OF THE REQUIRED STEEL FILLER PLATE, t^f, IS LESS THAN OR EQUAL TO 5mm, THE FILLER PLATE SIZE SHALL BE 120x60xt_f. THE SIZE OF THE WELD CONNECTING THE COMBINATION OF PLATES TO THE ANGLE SHALL BE INCREASED BY THE THICKNESS OF THE FILLER PLATE.
8. IF THE THICKNESS OF THE REQUIRED STEEL FILLER PLATE, t^f, IS GREATER THAN 5mm, THE FILLER PLATE SIZE SHALL BE 150x75xt_f, AND SHALL BE WELDED TO THE ANGLE WITH A WELD SIZE OF 2mm LESS THAN THE THICKNESS OF THE PLATE BUT NOT LESS THAN 6mm. THE 120x120x12mm PLATE SHALL BE WELDED ALL AROUND WITH AN 8mm WELD AS SHOWN.
9. IF ANCHORD EMBEDDED STEEL BEARING PLATES ARE REQUIRED THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.

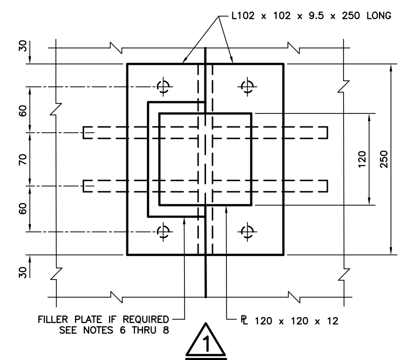


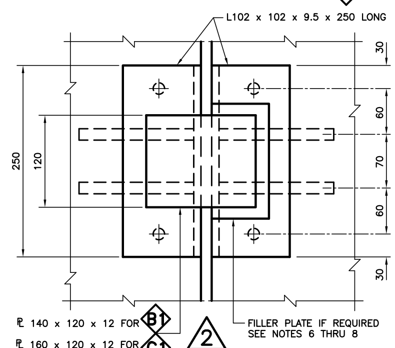
ELEVATION

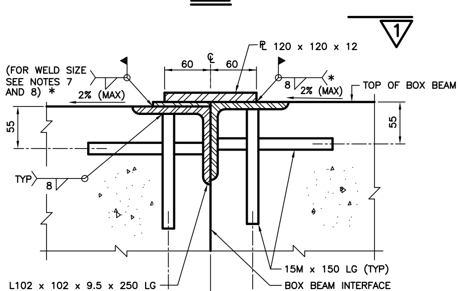
POSITIVE MOMENT CONNECTION AT PIERS

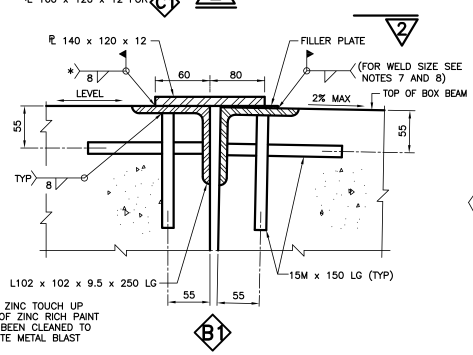
NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. TRANSVERSE TIES SHALL BE PROVIDED BETWEEN GIRDER AT LOCATIONS ACCORDING TO THE DESIGN TABLE AND TO BE SHOWN ON THE GIRDERS LAYOUT PLAN.
5. IF INSERTS FOR CANTILEVER REINFORCEMENT ARE REQUIRED, THEY SHALL BE DETAILED BY THE DESIGNER.
6. IF CROSS FALL OF DECK IS GREATER THAN 2%, DESIGNER SHALL MODIFY THE TRANSVERSE TIE DETAILS B1 OR C1 TO SUIT.
7. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.





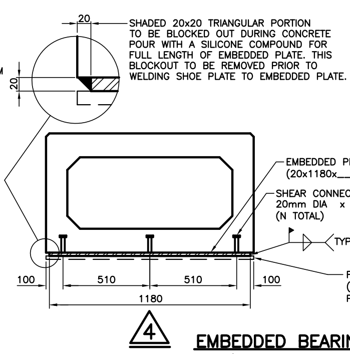




* AFTER WELDING APPLY ZINC TOUCH UP SOLDER OR 2 COATS OF ZINC RICH PAINT AFTER THE AREA HAS BEEN CLEANED TO SSPC–SP10–NEAR WHITE METAL BLAST

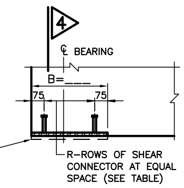
(A2 SIMILAR BUT OPPOSITE HAND)

(B2 SIMILAR BUT OPPOSITE HAND)



EMBEDDED BEARING PLATE DETAIL
(NON INTEGRAL ABUTMENT ENDS ONLY)

EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B<450mm	2	6
450mm≤B<750mm	3	9
750mm≤B<1050mm	4	12



ELEVATION

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107–15

PRESTRESSED BOX GIRDERS DETAILS

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC–14	CL 625–ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No

WP No

SHEET

PRESTRESSED NU GIRDERS AND BEARINGS (NU 900) (STEEL REBAR)

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

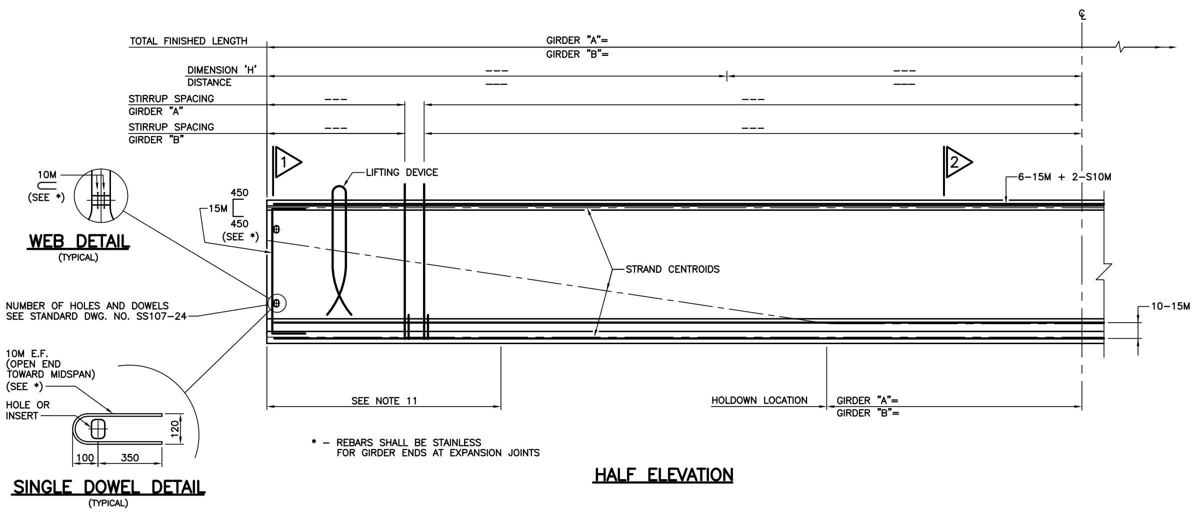
BEARING DATA

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

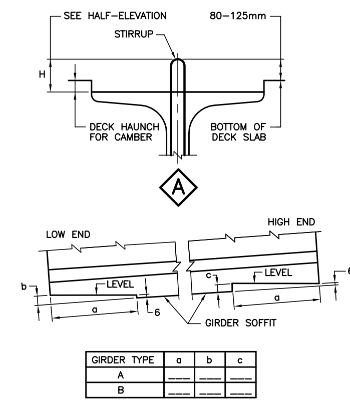
NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W.
   STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    -SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/-5mm
    -TOP OF BEAM 25 + 5mm/-5mm
    -UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



* - REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

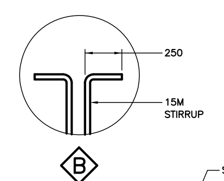
HALF ELEVATION



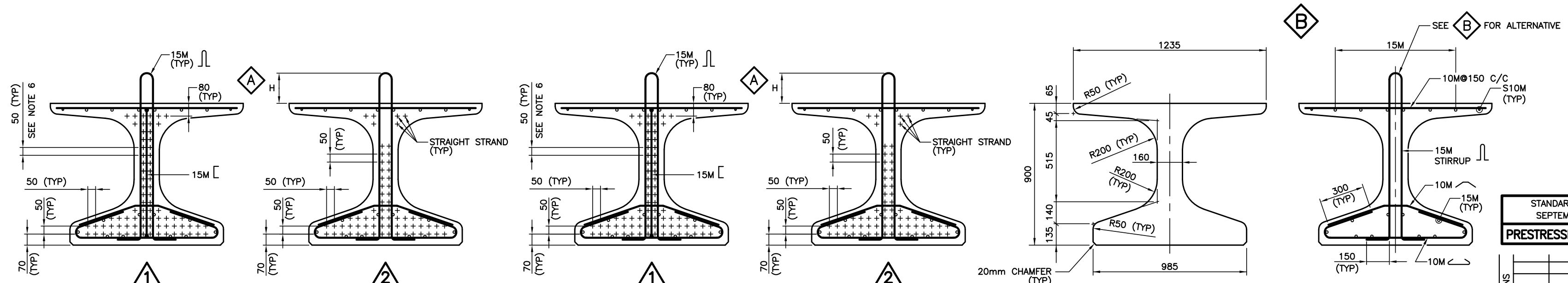
GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS

(c = 9, 12, 15 or 18mm)



NU 900



GIRDER A

GIRDER B

TYPICAL SECTION

REINFORCING

____ DEFLECTED STRANDS
____ STRAIGHT STRANDS

____ DEFLECTED STRANDS
____ STRAIGHT STRANDS

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107-16

PRESTRESSED NU GIRDERS AND BEARINGS (NU 900)

REVISIONS			
	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14 CL 625-ONT	DATE
DRAWN	CHK	SITE	DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

CONT No

WP No

SHEET

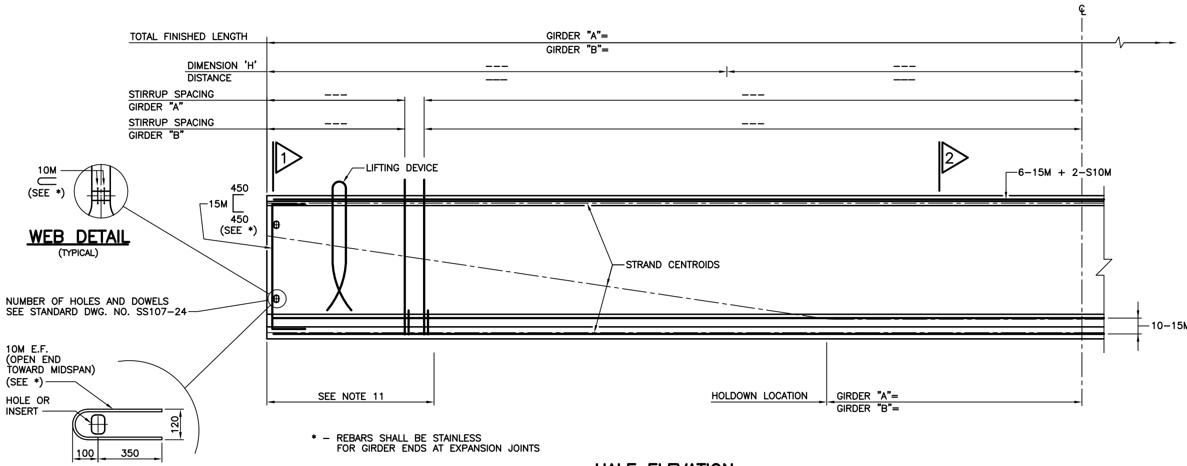
PRESTRESSED NU GIRDERS AND BEARINGS (NU 1200) (STEEL REBAR)

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

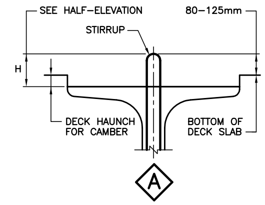


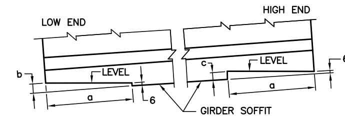
WEB DETAIL
(TYPICAL)

SINGLE DOWEL DETAIL
(TYPICAL)

* – REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

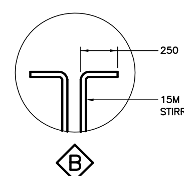
HALF ELEVATION





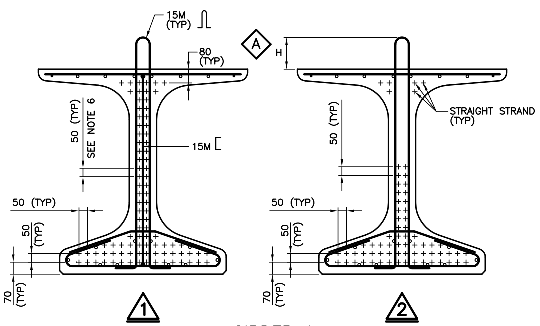
GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)

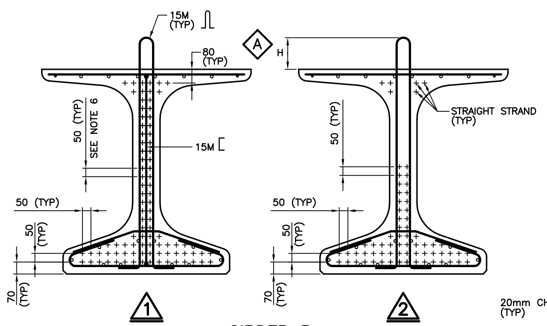


NOTES:

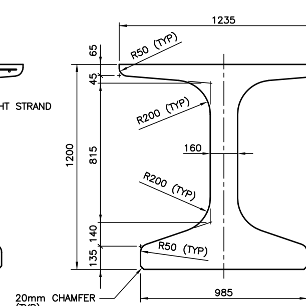
1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    -SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/-5mm
    -TOP OF BEAM 25 + 5mm/-5mm
    -UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



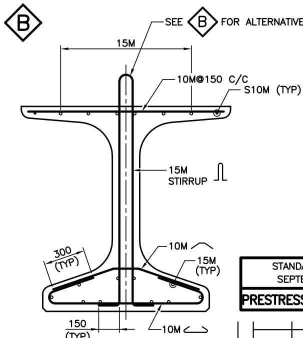
GIRDER A
____ DEFLECTED STRANDS
____ STRAIGHT STRANDS



GIRDER B
____ DEFLECTED STRANDS
____ STRAIGHT STRANDS



TYPICAL SECTION



REINFORCING

NU 1200

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107-17

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1200)

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

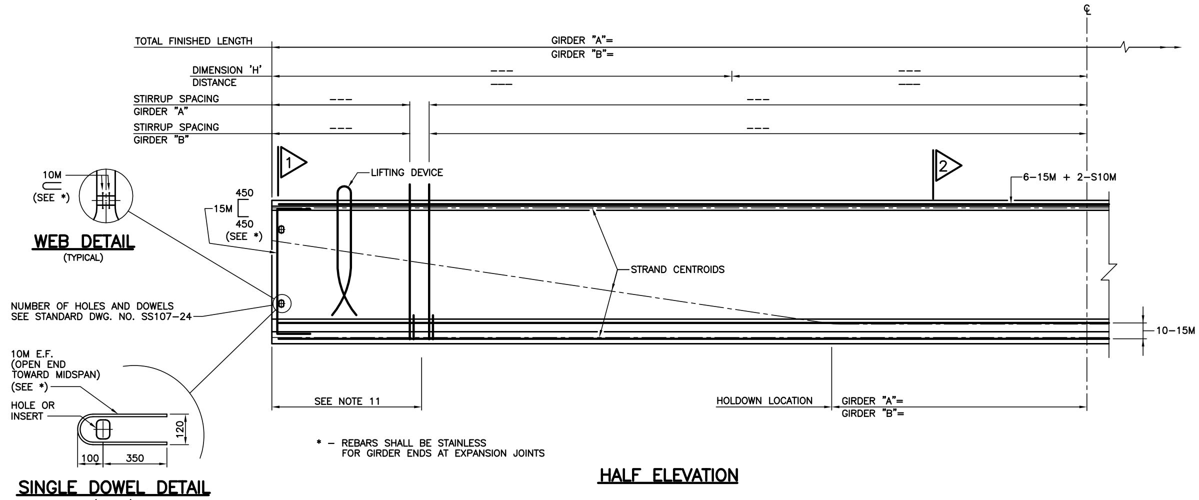
CONT No
WP No

SHEET

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1400) (STEEL REBAR)

NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    -SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/-5mm
    -TOP OF BEAM 25 + 5mm/-5mm
    -UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.

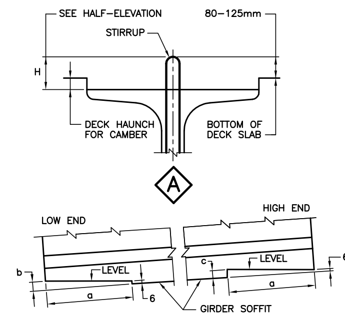


WEB DETAIL
(TYPICAL)

SINGLE DOWEL DETAIL
(TYPICAL)

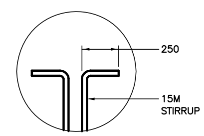
* - REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

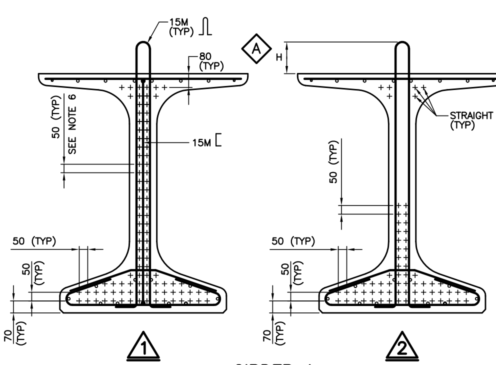
HALF ELEVATION



GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

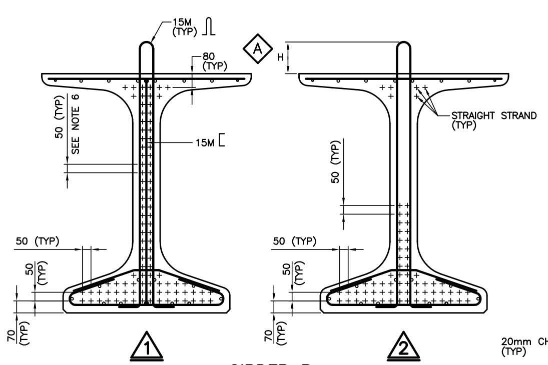
GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)





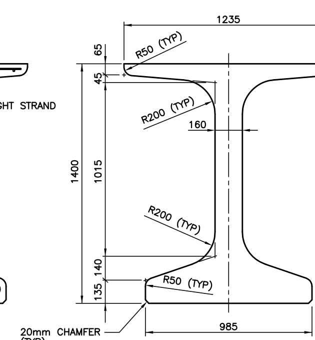
GIRDER A

___ DEFLECTED STRANDS
___ STRAIGHT STRANDS

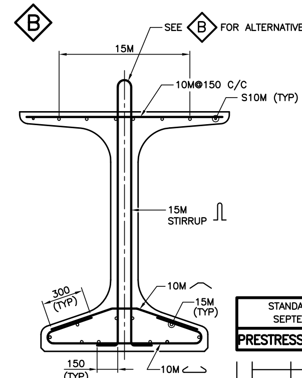


GIRDER B

___ DEFLECTED STRANDS
___ STRAIGHT STRANDS



TYPICAL SECTION



REINFORCING

NU 1400

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS107-18

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1400)

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

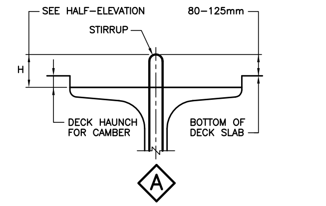
CONT No
WP No

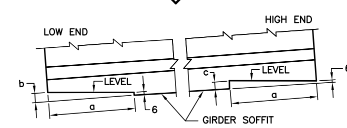
PRESTRESSED NU GIRDERS AND BEARINGS (NU 1600) (STEEL REBAR)

SHEET

NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    -SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/-5mm
    -TOP OF BEAM 25 + 5mm/-5mm
    -UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/-5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.

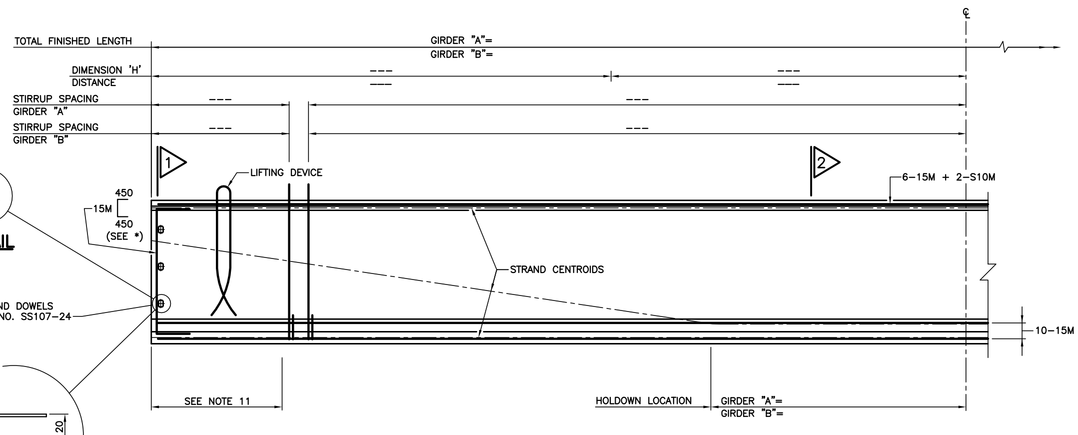


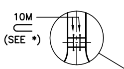


GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS

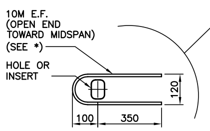
(c = 9, 12, 15 or 18mm)





WEB DETAIL

(TYPICAL)

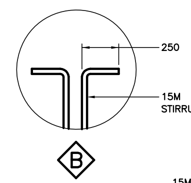


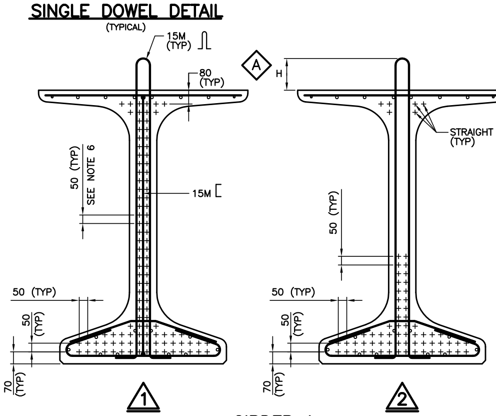
SINGLE DOWEL DETAIL

(TYPICAL)

* - REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

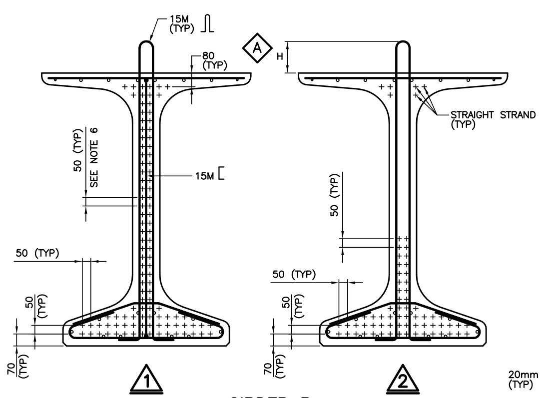
HALF ELEVATION





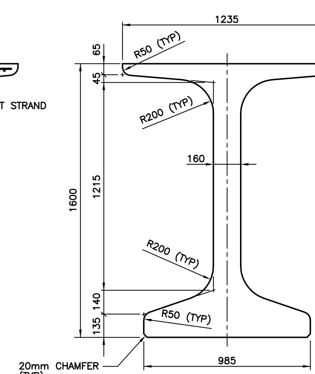
GIRDER A

____ DEFLECTED STRANDS
____ STRAIGHT STRANDS

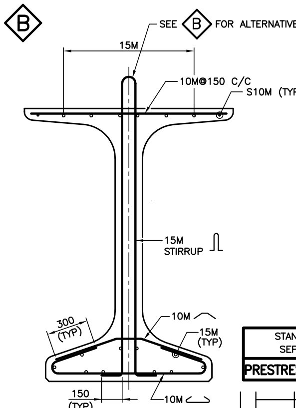


GIRDER B

____ DEFLECTED STRANDS
____ STRAIGHT STRANDS



TYPICAL SECTION



REINFORCING

NU 1600

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

STANDARD DRAWING SEPTEMBER 2016 | SS107-19

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1600)

REVISIONS				
	DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

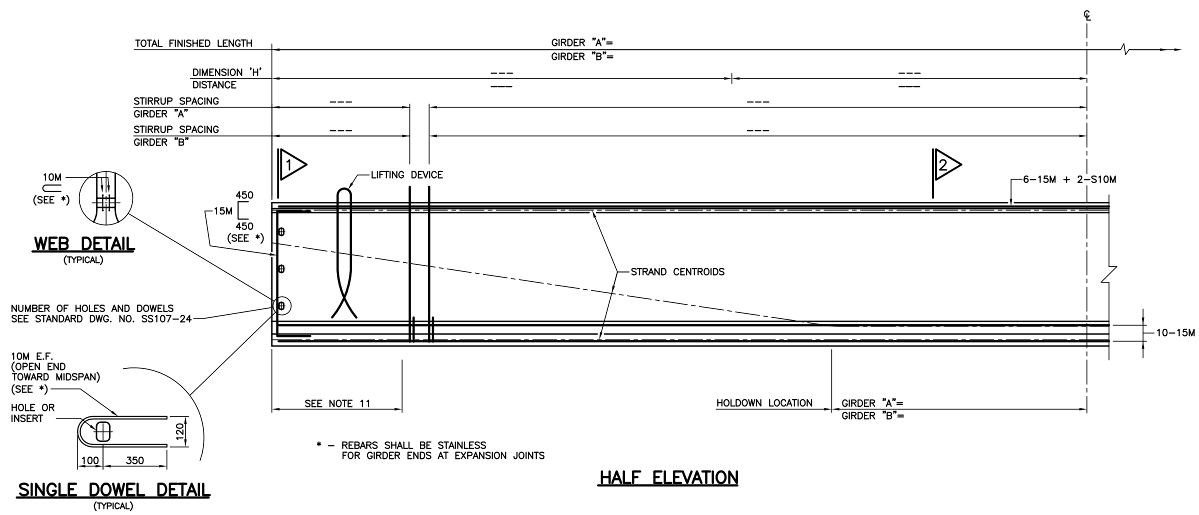
PRESTRESSED NU GIRDERS AND BEARINGS (NU 1800) (STEEL REBAR)

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

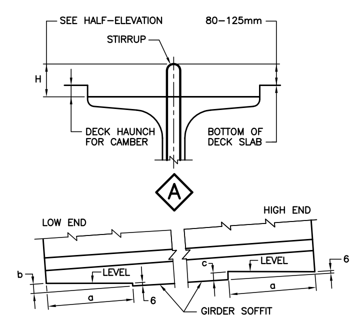
NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



* – REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

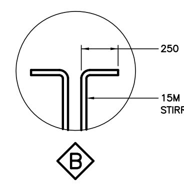
HALF ELEVATION



GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

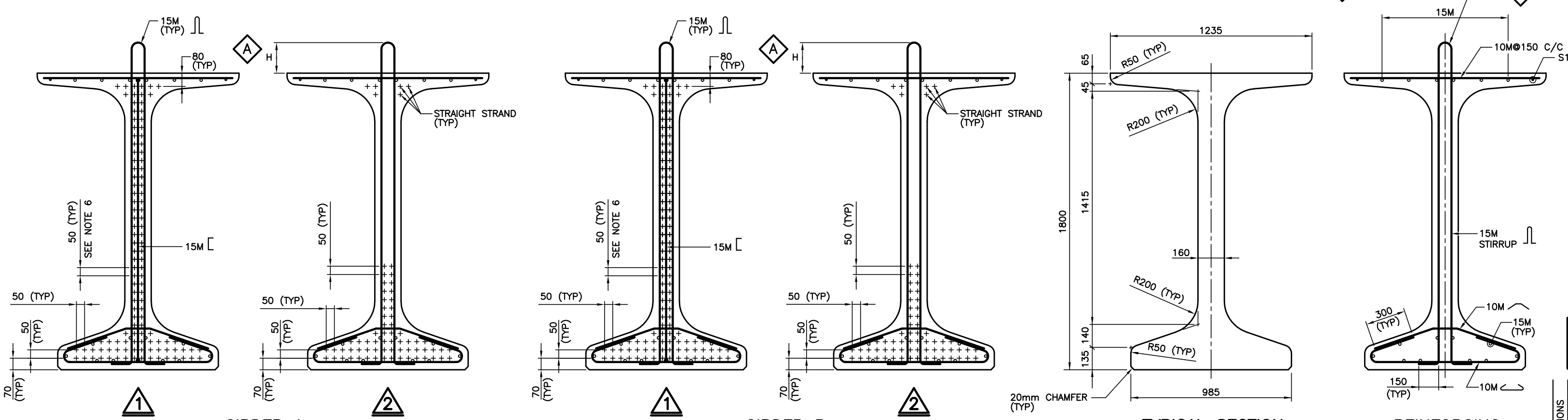
GIRDER SOFFIT DETAIL AT BEARINGS

(c = 9, 12, 15 or 18mm)



NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    –SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/–5mm
    –TOP OF BEAM 25 + 5mm/–5mm
    –UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/–5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



GIRDER A
____ DEFLECTED STRANDS
____ STRAIGHT STRANDS

GIRDER B
____ DEFLECTED STRANDS
____ STRAIGHT STRANDS

TYPICAL SECTION

REINFORCING

NU 1800

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS107-20

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1800)

REVISIONS			
DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1900) (STEEL REBAR)

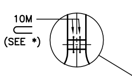
SHEET

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

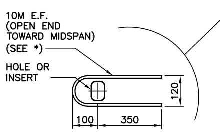
BEARING DATA

NOTES TO DESIGNER

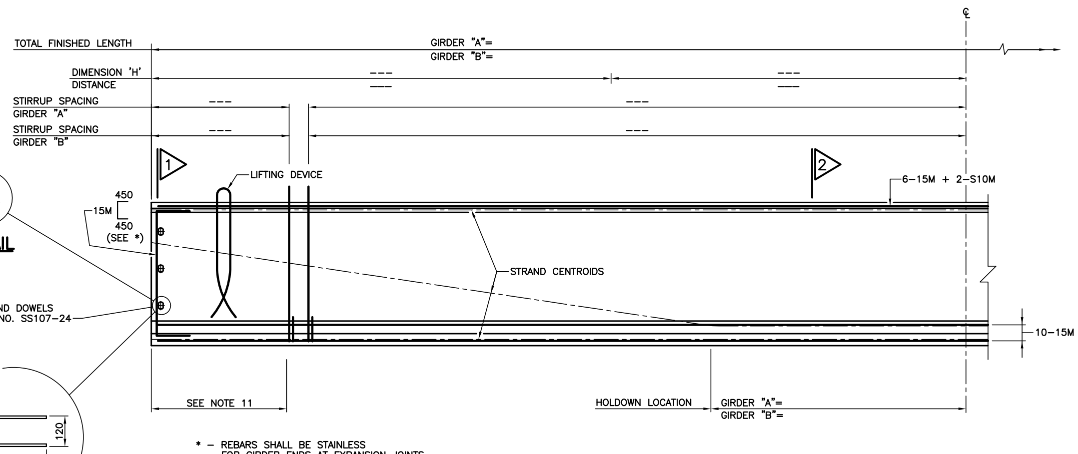
1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



WEB DETAIL
(TYPICAL)

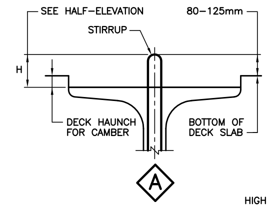


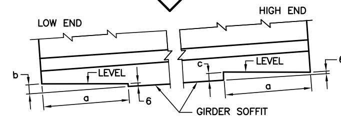
SINGLE DOWEL DETAIL
(TYPICAL)



* – REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

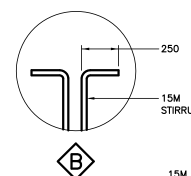
HALF ELEVATION





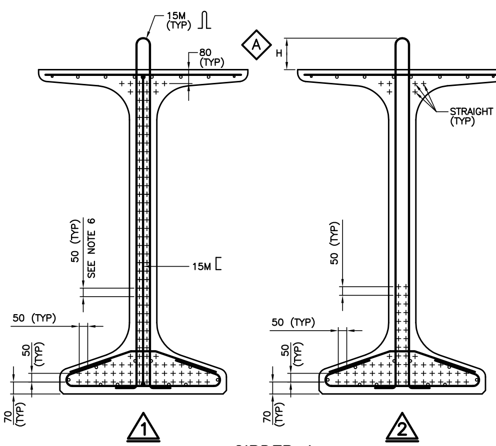
GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)

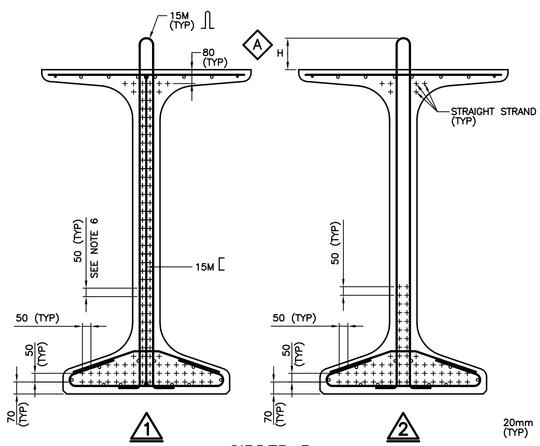


NOTES:

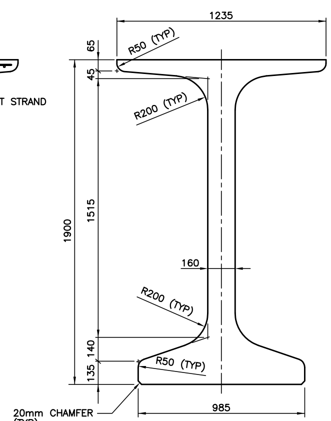
1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    –SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/–5mm
    –TOP OF BEAM 25 + 5mm/–5mm
    –UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/–5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 1500mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



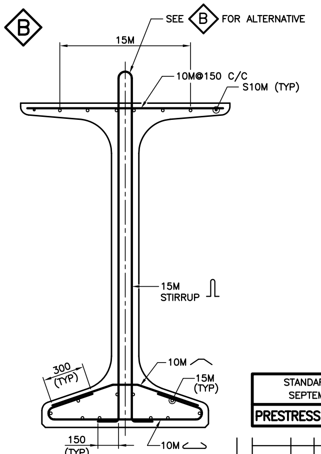
GIRDER A
___ DEFLECTED STRANDS
___ STRAIGHT STRANDS



GIRDER B
___ DEFLECTED STRANDS
___ STRAIGHT STRANDS



TYPICAL SECTION



REINFORCING

NU 1900

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | **SS107-21**

PRESTRESSED NU GIRDERS AND BEARINGS (NU 1900)

REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

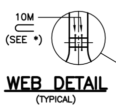
PRESTRESSED NU GIRDERS AND BEARINGS (NU 2000) (STEEL REBAR)

	LOCATION	ABUTMENTS	PIERS
	TYPE	___	___
	SIZE (mm)	___x___x___	___x___x___
	NUMBER REQUIRED	___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

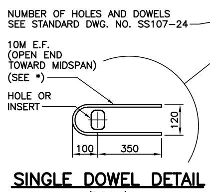
BEARING DATA

NOTES TO DESIGNER

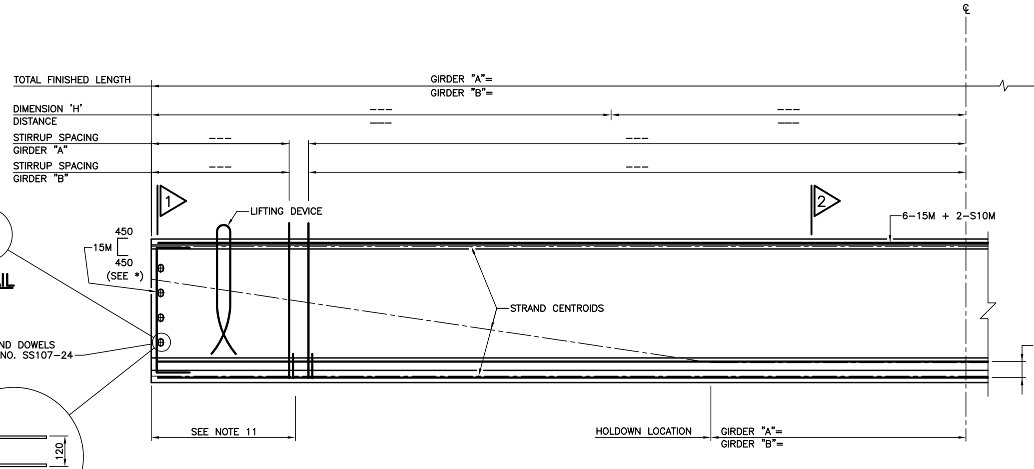
1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



WEB DETAIL
(TYPICAL)

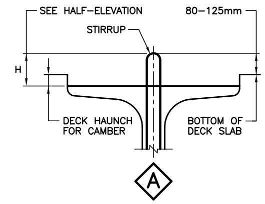


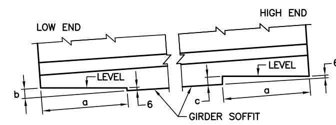
SINGLE DOWEL DETAIL
(TYPICAL)



* – REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

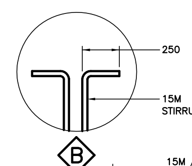
HALF ELEVATION





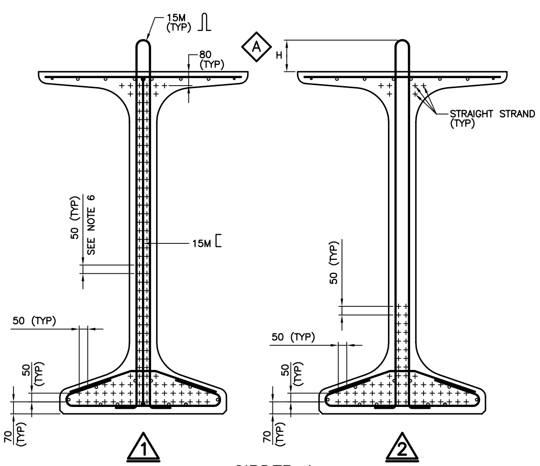
GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS
(c = 9, 12, 15 or 18mm)



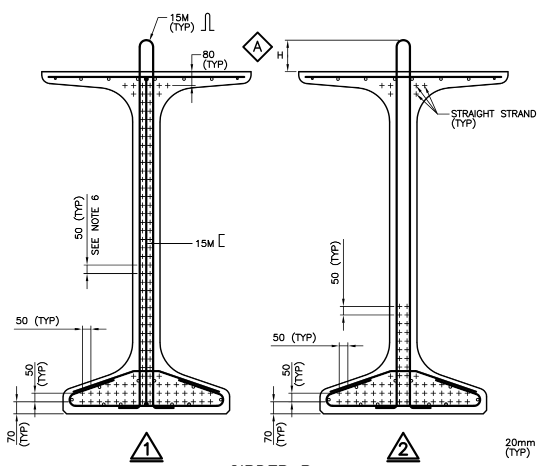
NOTES:

1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    –SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/–5mm
    –TOP OF BEAM 25 + 5mm/–5mm
    –UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/–5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 2000mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



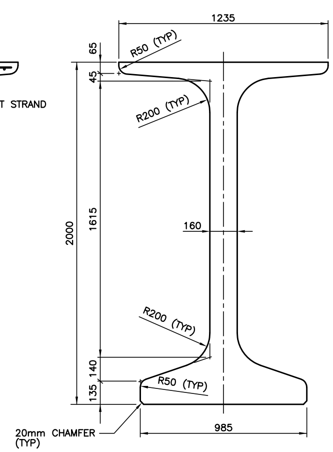
GIRDER A

___ DEFLECTED STRANDS
___ STRAIGHT STRANDS

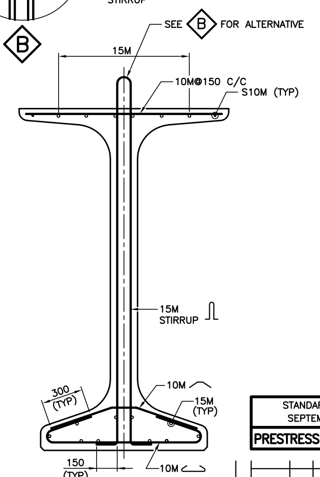


GIRDER B

___ DEFLECTED STRANDS
___ STRAIGHT STRANDS



TYPICAL SECTION



REINFORCING

NU 2000

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS107-22

PRESTRESSED NU GIRDERS AND BEARINGS (NU 2000)

REVISIONS					
			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

LOCATION		ABUTMENTS	PIERS
TYPE		___	___
SIZE (mm)		___x___x___	___x___x___
NUMBER REQUIRED		___	___
SERVICEABILITY LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___
	MOVEMENT (mm)	+/- ___	+/- ___
	ROTATION (radian)	___	___
	MAX. SHEAR RATE (kN/mm)	___	___
ULTIMATE LIMIT STATES	DEAD LOAD (kN)	___	___
	TOTAL LOAD (kN)	___	___

BEARING DATA

NOTES TO DESIGNER

1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARING MAY HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. THE DESIGNER SHALL SPECIFY ONE OF THE CLASS OF CONCRETE FOR PRECAST GIRDERS IN NOTE NO. 7 AND DELETE THE OTHER.
5. ROTATION IN BEARING DATA TABLE CORRESPONDS TO TOTAL LOAD.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

METRIC

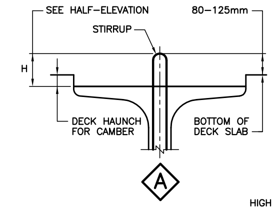
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

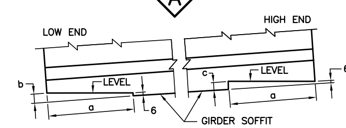
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

PRESTRESSED NU GIRDERS AND BEARINGS (NU 2400) (STEEL REBAR)

SHEET





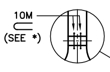
GIRDER TYPE	a	b	c
A	___	___	___
B	___	___	___

GIRDER SOFFIT DETAIL AT BEARINGS

(c = 9, 12, 15 or 18mm)

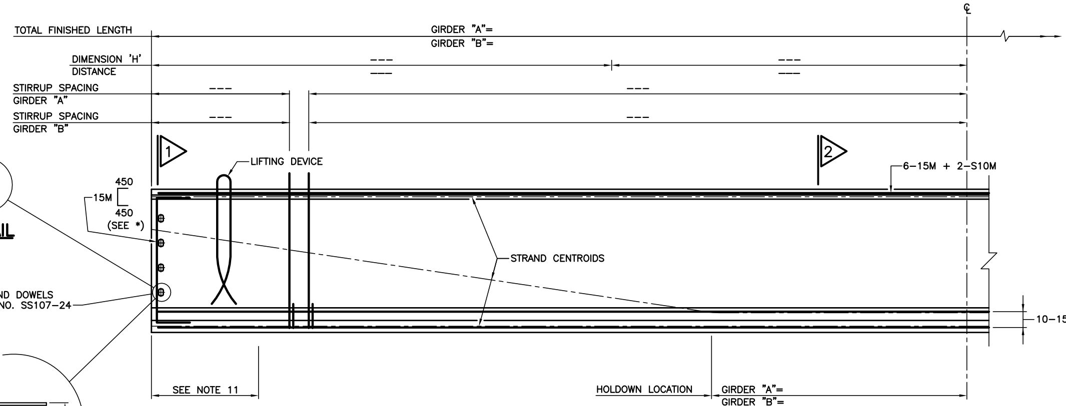
NOTES:

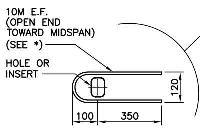
1. PRESTRESSING STEEL SHALL BE LOW-RELAXATION SEVEN WIRE STRANDS, SIZE DESIGNATION 15, GRADE 1860.
2. MINIMUM BREAKING STRENGTH OF STRAND 261kN.
3. JACKING FORCE PER STRAND _____ kN.
4. FORCE PER STRAND AFTER ALL LOSSES _____ kN.
5. THE ELAPSED TIME INTERVAL BETWEEN JACKING OF STRANDS AND TRANSFER SHALL NOT BE LESS THAN 15 HOURS.
6. PRESTRESSING STRANDS SHALL BE SPACED VERTICALLY AT A MINIMUM OF 150mm IN THE VICINITY OF RECTANGULAR HOLES OR INSERTS FOR 20M DOWELS.
7. CLASS OF CONCRETE:
   PRECAST GIRDERS __ MPa
   PRECAST GIRDERS __ MPa (CONCRETE CONTAINING SILICA FUME)
8. MIN. CONCRETE STRENGTH AT TRANSFER __ MPa.
9. REINFORCING STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
10. CLEAR COVER TO REINFORCING STEEL UNLESS SHOWN OTHERWISE:
    –SOFFIT OF BEAM (EXCEPT UNDERCUT) 46 +15mm/–5mm
    –TOP OF BEAM 25 + 5mm/–5mm
    –UNDERCUT OF BEAM AND ELSEWHERE 30 +15mm/–5mm
11. ALL TRANSVERSE REINFORCEMENT IN BOTTOM FLANGE, INCLUDING STIRRUPS, LOCATED WITHIN 2000mm FROM THE GIRDER ENDS AT EXPANSION JOINTS SHALL BE STAINLESS.
12. FOR BRIDGES ON GRADES EXCEEDING 3%, THE ENDS OF GIRDERS SHALL BE CAST SO THAT THEY ARE VERTICAL WHEN ERECTED.
13. DRAWING TO BE READ IN CONJUNCTION WITH SS107-24.
14. NO WELDING SHALL BE PERMITTED UNLESS APPROVED BY THE OWNER.



WEB DETAIL

(TYPICAL)



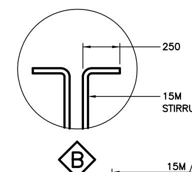


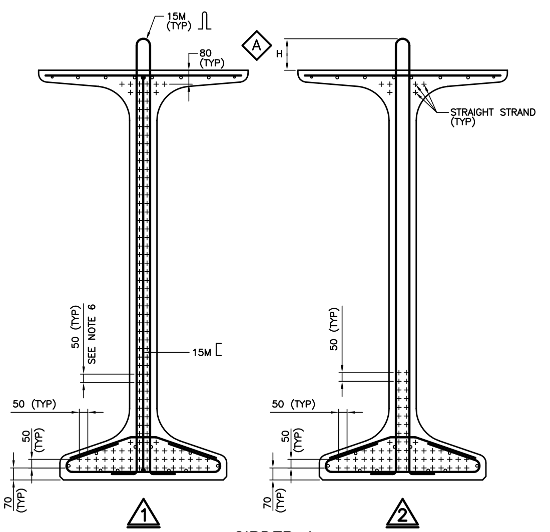
* – REBARS SHALL BE STAINLESS FOR GIRDER ENDS AT EXPANSION JOINTS

HALF ELEVATION

SINGLE DOWEL DETAIL

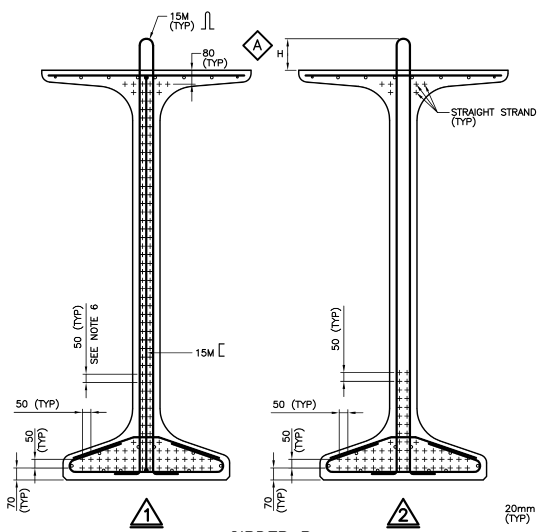
(TYPICAL)





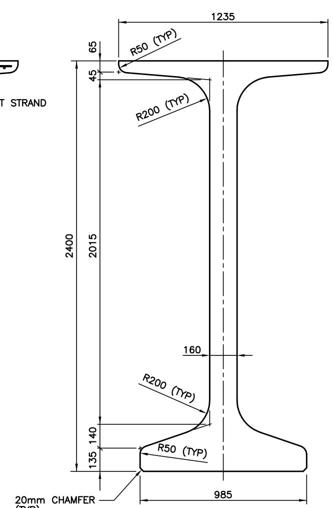
GIRDER A

___ DEFLECTED STRANDS
___ STRAIGHT STRANDS

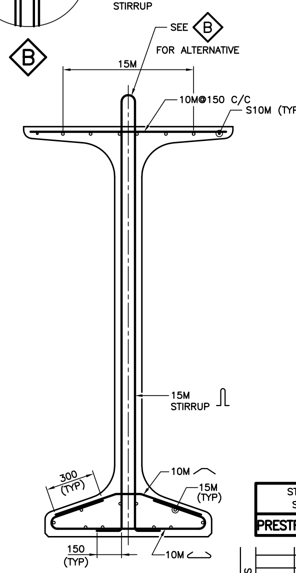


GIRDER B

___ DEFLECTED STRANDS
___ STRAIGHT STRANDS



TYPICAL SECTION



REINFORCING

NU 2400

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS107-23

PRESTRESSED NU GIRDERS AND BEARINGS (NU 2400)

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC

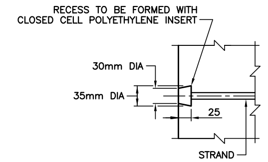
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

PRESTRESSED NU GIRDERS DETAILS

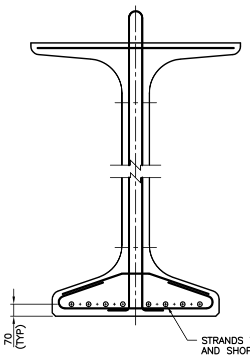


AFTER TRANSFER:
INSERT TO BE REMOVED AND STRAND TO BE CUT BACK TO 25mm FROM END OF GIRDER USING AN OXYGEN FED HOLLOW STEMMED THERMIC LANCE. RECESS TO BE CLEANED AND FILLED WITH NON-SHRINK GROUT.

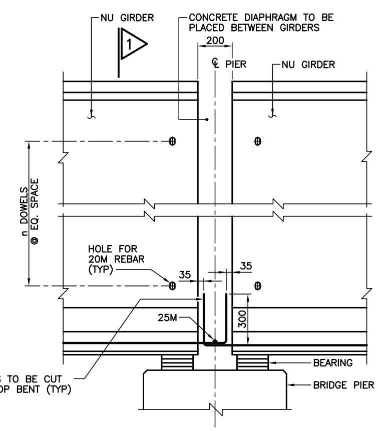
STRAND TREATMENT FOR GIRDER ENDS AT EXPANSION JOINTS

NOTES:

1. THIS DRAWING SHOWS TYPICAL DETAILS FOR PRESTRESSED NU GIRDERS AND IS TO BE READ IN CONJUNCTION WITH DRAWING SS107-__.
2. DOWEL INSERTS SHALL BE ZINC PLATED OR HOT-DIP GALVANIZED.
3. DOWEL INSERTS SHALL BE CAPABLE OF DEVELOPING A FORCE IN TENSION OF 20KN AT SERVICEABILITY LIMIT STATE LOADING.
4. FOR THE DIAPHRAGM, THE PRECASTER WILL SUPPLY THE THREADED INSERTS AND THE MATCHING DIAPHRAGM DOWELS FOR THE EXTERIOR GIRDERS ONLY.
5. 20M DEFORMED BAR DOWELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS.
6. AT ENDS OF GIRDERS WHICH ARE NOT TO BE ENCASED IN CONCRETE, STRAND ENDS SHALL BE RECESSED AND GROUTED, AND GIRDER END FACE SHALL BE PAINTED WITH TWO COATS OF ASPHALTIC PAINT.
7. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED AT GIRDERS ENDS, THEY SHALL HAVE A THICKNESS OF 20mm. THEY SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL DAMAGED GALVANISED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC-RICH PAINT.
8. IF ANCHORED EMBEDDED STEEL BEARING PLATES ARE REQUIRED THE REINFORCING MAY BE ADJUSTED SLIGHTLY TO ACCOMMODATE THE SHEAR CONNECTORS.
9. DIMENSION MAY BE ADJUSTED TO ENSURE NO INTERFERENCE WITH DEFLECTED STRANDS.

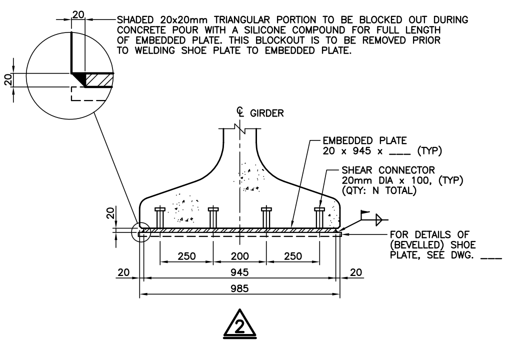


(OTHER REINFORCING OMITTED FOR CLARITY)

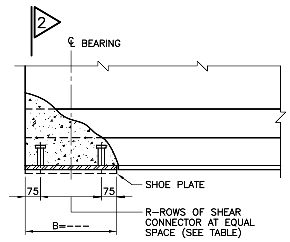


POSITIVE MOMENT CONNECTION AT PIER

(WITHOUT POST-TENSIONING)



EMBEDDED BEARING PLATE DETAIL



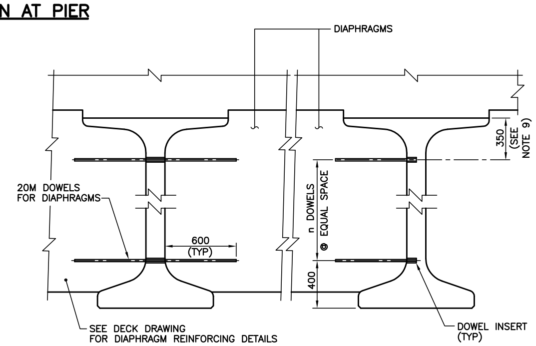
ELEVATION

EMBEDDED PLATE LENGTH (B)	NO. OF ROWS OF SHEAR CONNECTOR (R)	TOTAL NO. OF SHEAR CONNECTOR (N)
B ≤ 450mm	2	8
450mm < B ≤ 750mm	3	12
750mm < B ≤ 1050mm	4	16

NOTES TO DESIGNER

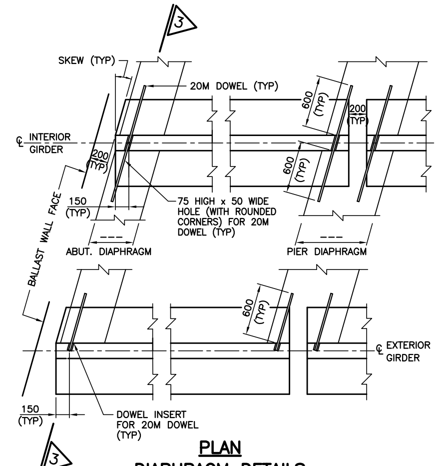
1. FOR INTEGRAL ABUTMENT TYPE BRIDGES, THIS STANDARD DRAWING WILL NEED TO BE MODIFIED AS REQUIRED.
2. ANCHORED EMBEDDED STEEL BEARING PLATES WITH PINTLED BEVEL PLATES SHALL BE USED ONLY IF THE CALCULATED REQUIRED GIRDER SOFFIT UNDERCUT DIMENSION EXCEEDS 18mm.
3. THE BEVELLED SHOE PLATE USED WITH ELASTOMERIC BEARINGS SHALL HAVE PINTLES. THE DESIGNER SHALL DETAIL THIS REQUIREMENT.
4. DOWEL SIZE IN DIAPHRAGM SHALL BE INCREASED AND DETAIL SHALL BE ADJUSTED IF REQUIRED BY DESIGN.
5. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

GIRDER DEPTH	NO. OF DOWELS (n)
900	2
1200	2
1400	2
1600	3
1800	3
1900	3
2000	4
2400	4



INTERIOR GIRDER **EXTERIOR GIRDER**

3



PLAN
DIAPHRAGM DETAILS

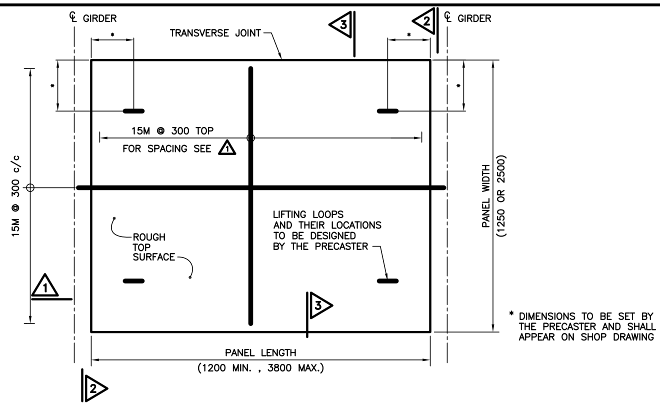
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

STANDARD DRAWING
SEPTEMBER 2016

SS107-24

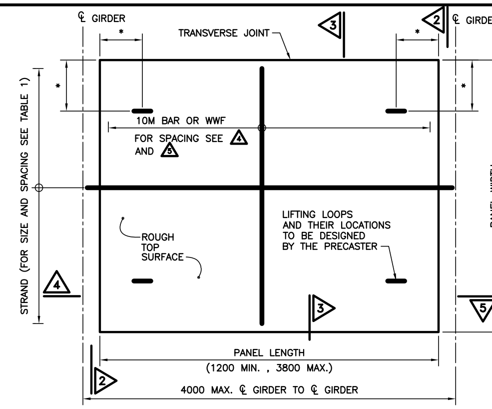
PRESTRESSED NU GIRDERS – DETAILS

REVISIONS		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG



PLAN OF TYPICAL UNSTRESSED DECK PANEL

(OPTIONAL, FOR PANEL LENGTHS LESS THAN 1400mm)



PLAN OF TYPICAL PRESTRESSED DECK PANEL

(ALL PANEL LENGTHS)

METRIC

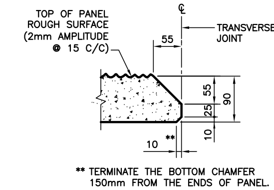
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No
SHEET

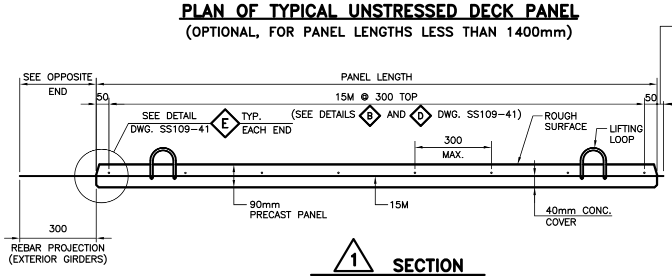
PRECAST DECK PANELS FOR CONCRETE GIRDERS – DETAILS I

NOTES TO DESIGNER:

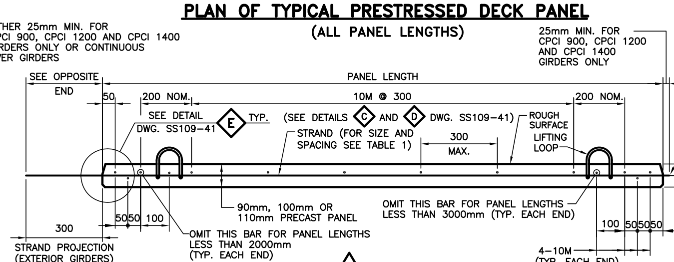
1. DETAILS IN THIS STANDARD DRAWING ARE NOT INTENDED FOR NU GIRDERS. FOR NU GIRDERS, THE DESIGNER SHALL CHECK THE GIRDER AND THE DETAIL ADEQUACY AND MODIFY THIS STANDARD DRAWING TO SUIT. DESIGNER SHALL ALSO MODIFY THE NU GIRDER STANDARD DRAWING AS REQUIRED.
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



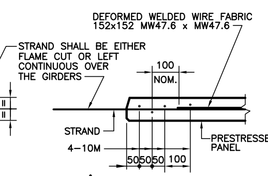
3 SECTION



1 SECTION UNSTRESSED PANEL



4 SECTION PRESTRESSED PANEL



5 SECTION

(ALTERNATE DETAIL WITH WWF)
(PRESTRESSED PANELS ONLY)

TABLE 1

TABLE OF PRESTRESS DATA														
PANEL LENGTH (m)	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8
STRAND DIA. (mm)	9 mm DIA													
STRAND SPACING (mm)	300	300	300	300	275	250	225	175	150	125	100	100	75	75
JACKING FORCE (kN)	77 kN													
BREAKING STRENGTH (kN)	102 kN													
PANEL THICKNESS (mm)	90 mm											100	110 mm	
	SEE SECTION 4 AND DETAILS C AND D													
OPTIONAL	SEE SECTION 1 AND DETAIL B 15M@300c/c													

GENERAL NOTES:

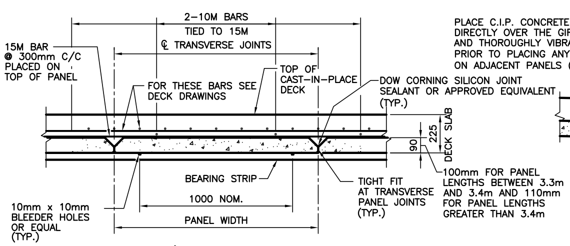
1. THESE DRAWINGS SHOW DETAILS FOR STAY-IN-PLACE PRECAST CONCRETE BRIDGE DECK PANELS FOR USE WITH CONCRETE GIRDERS.
2. PRECAST DECK PANELS MAY BE USED AS AN ALTERNATIVE TO FALSEWORK.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. SS109-41 AND THE ASSOCIATED SPECIAL PROVISIONS FOR PRECAST PANELS.
4. THE TOTAL COMPOSITE DECK SLAB THICKNESS SHALL BE 225mm.
5. SHOP DRAWINGS SHOWING PANEL LAYOUT AND ASSOCIATED CONSTRUCTION DETAILS SHALL BE PRODUCED BY THE CONTRACTOR.
6. PANELS WITH LENGTHS GREATER THAN 2.5m SHALL BE AT LEAST 30 DAYS OLD BEFORE INSTALLATION.
7. THE BEARING STRIPS THAT ARE USED TO SUPPORT THE PANEL PRIOR TO POURING THE CAST-IN-PLACE TOPPING SHALL BE DETAILED BY THE PRECASTER AND SHALL REMAIN IN PLACE EXCEPT WHEN USED WITH A TIMBER SUPPORT SYSTEM.
8. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE PANELS DURING CONSTRUCTION.
9. THE LONGITUDINAL REINFORCEMENT PLACED DIRECTLY ON THE PRECAST PANEL SHALL NOT HAVE LAP SPLICES OVER THE TRANSVERSE PANEL JOINTS.

DESIGN CRITERIA:

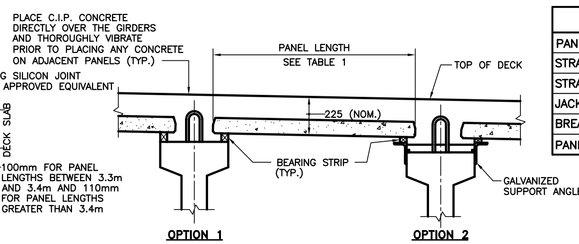
1. ASSUMED CONSTRUCTION LOADING 2.4kPa OF DECK SURFACE AREA.
2. THE DECK PANELS ARE DESIGNED AS NON COMPOSITE TO SUPPORT THE DEAD LOAD OF THE PANEL, THE CAST-IN-PLACE CONCRETE TOPPING, 2.4 kPa OF CONSTRUCTION LOADING AND DESIGNED COMPOSITELY TO SUPPORT 90mm OF ASHPALT AND CHBDC TRAFFIC LOADS.
3. PANELS WITH LENGTHS EQUAL TO OR GREATER THAN 1400mm SHALL BE PRESTRESSED.
4. PANELS WITH LENGTHS LESS THAN 1400mm MAY BE UNSTRESSED.
5. SLS DESIGN LIMIT FOR FLEXURAL STRESS FOR PRESTRESSED PANELS IS 2.5 MPa MAXIMUM TENSION AT THE MIDSPAN BOTTOM OF THE PANEL.
6. IF THE CONCRETE STRENGTH OF THE CORRESPONDING CAST IN PLACE DECK IS GREATER THAN 40 MPa, THEN THE STRENGTH OF THE PRECAST PANEL SHALL BE INCREASED TO MATCH.
7. WHEN THE REQUIRED PANEL LENGTH FALLS BETWEEN THOSE VALUES LISTED IN TABLE 1 THEN USE THE STRAND SPACING FOR THE LARGER LISTED PANEL LENGTH.

MATERIALS:

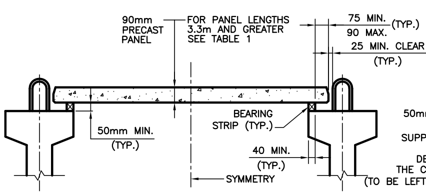
1. **CONCRETE STRENGTHS**
   30MPa AT STRAND RELEASE AND 40 MPa AT 28 DAYS.
2. **PRESTRESSING STEEL**
   PRESTRESSING STEEL SHALL BE LOW RELAXATION SEVEN WIRE STRAND, SIZE DESIGNATION 9mm DIA. GRADE 1860 MPa.
3. **REINFORCING STEEL**
   REINFORCING STEEL SHALL BE GRADE 400W.
4. **WIRE FABRIC**
   DEFORMED WELDED WIRE FABRIC SHALL CONFORM TO CSA G30.15-M1983 (R1991).



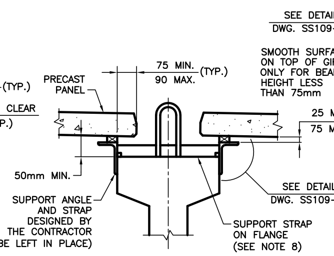
2 SECTION



HALF SECTIONS

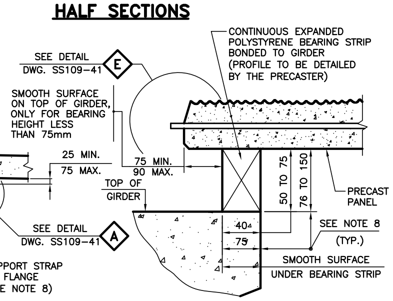


OPTION 1



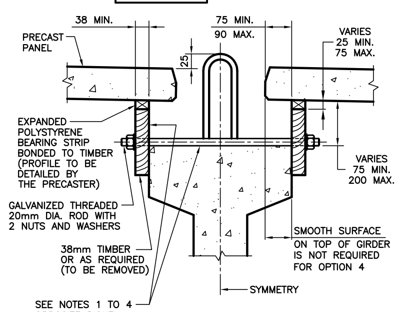
OPTION 2: ANGLE SUPPORT DETAIL

(SEE ALTERNATIVE DETAIL A)
DWG. SS109-41



OPTION 3

(TEMPORARY BEARING)



OPTION 4

NOTES:

1. SUPPORT SYSTEM TO BE DETAILED AND DESIGNED BY THE CONTRACTOR
2. MINIMUM REQUIRED CLEAR VERTICAL DISTANCE BETWEEN TOP OF GIRDER AND SOFFIT OF PANEL 75mm
3. BOND BREAKER TO BE APPLIED TO INSIDE FACE OF TIMBER AND TO TOP OF BEARING STRIP
4. THREADED ROD TO REMAIN IN PLACE, REMAINDER OF TIMBER SUPPORT SYSTEM TO BE REMOVED

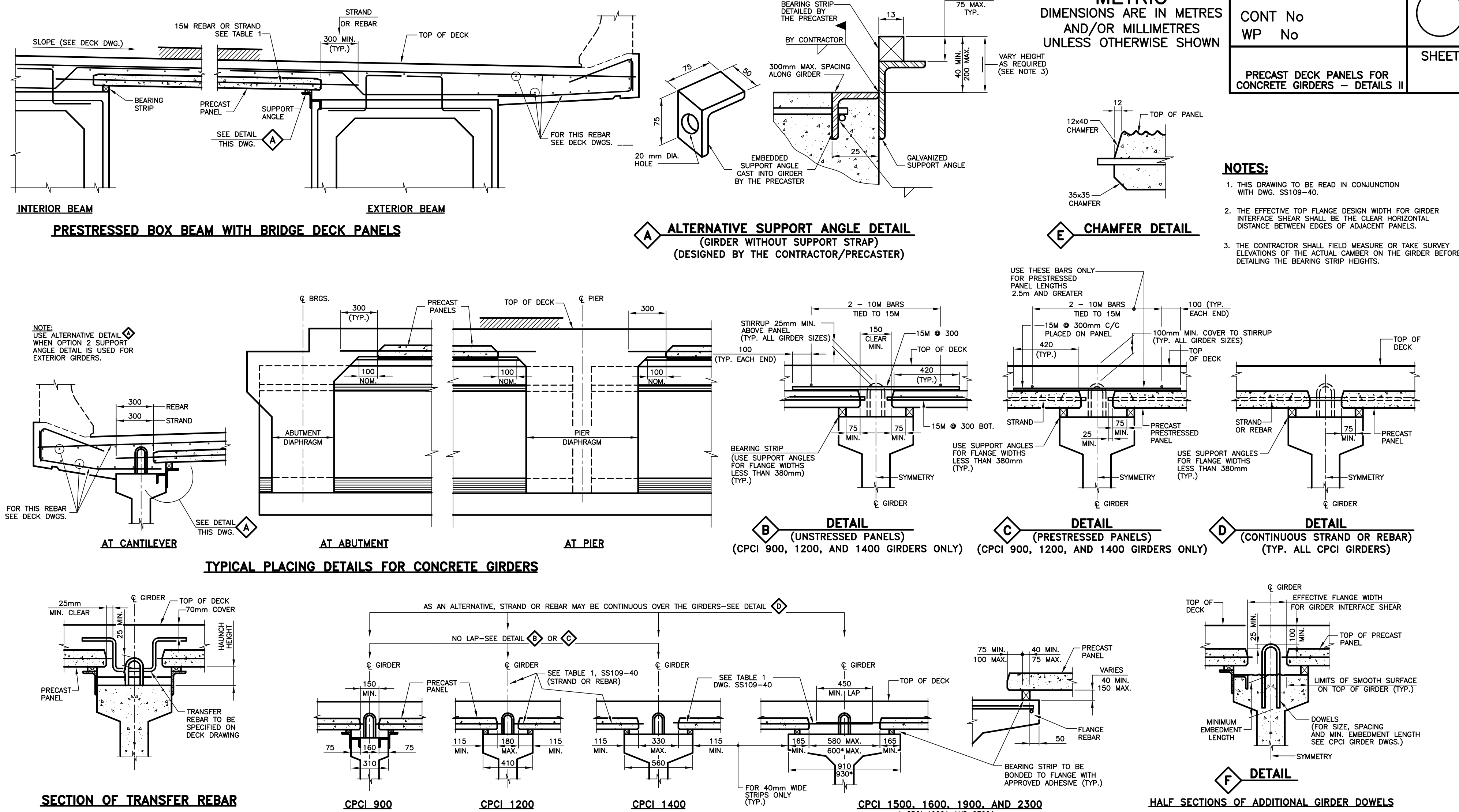
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING AUGUST 2015	SS109-40
PRECAST DECK PANELS FOR CONCRETE GIRDERS – DETAILS I	

REVISIONS | DESCRIPTION
DESIGN | CHK | CODE CHBDC-06 | CL 625-ONT | DATE
DRAWN | CHK | SITE | DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

PRECAST DECK PANELS FOR CONCRETE GIRDERS – DETAILS II

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH DWG. SS109-40.
2. THE EFFECTIVE TOP FLANGE DESIGN WIDTH FOR GIRDER INTERFACE SHEAR SHALL BE THE CLEAR HORIZONTAL DISTANCE BETWEEN EDGES OF ADJACENT PANELS.
3. THE CONTRACTOR SHALL FIELD MEASURE OR TAKE SURVEY ELEVATIONS OF THE ACTUAL CAMBER ON THE GIRDER BEFORE DETAILING THE BEARING STRIP HEIGHTS.

NOTE:
USE TRANSFER REBAR WHEN TOP OF GIRDER STIRRUP IS LESS THAN 25mm ABOVE TOP OF PANEL OR HAUNCH HEIGHT EXCEEDS 100mm.

SEE TABLE 1, SS109-40 (STRAND OR REBAR)

ASSEMBLY DETAILS FOR CPCI GIRDERS
(FOR FLANGE WIDTHS 910mm AND GREATER LAP THE STRAND OR REBAR AS SHOWN ABOVE)

NOTES TO DESIGNER:

1. DETAILS IN THIS STANDARD DRAWING ARE NOT INTENDED FOR NU GIRDERS. FOR NU GIRDERS, THE DESIGNER SHALL CHECK THE GIRDER AND THE DETAIL ADEQUACY AND MODIFY THIS STANDARD DRAWING TO SUIT. DESIGNER SHALL ALSO MODIFY THE NU GIRDER STANDARD DRAWING AS REQUIRED.
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING AUGUST 2015 | SS109–41

PRECAST DECK PANELS FOR CONCRETE GIRDERS – DETAILS II

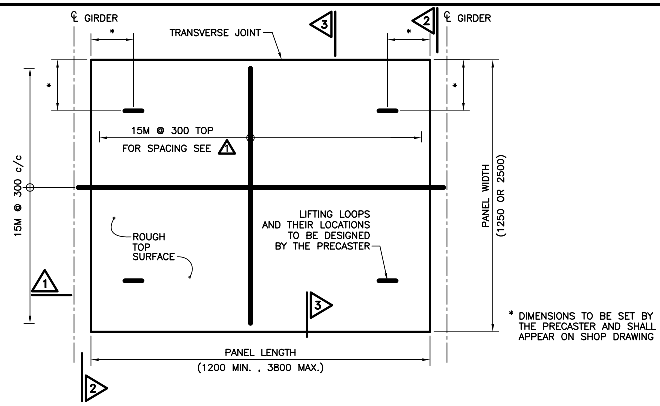
REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-06	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

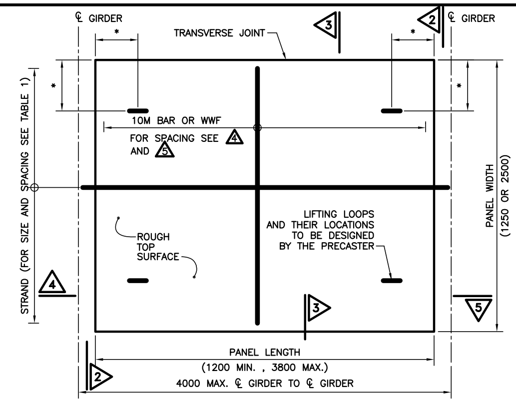
CONT No
WP No

SHEET

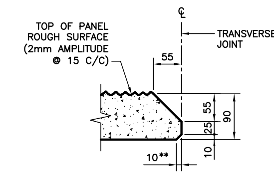
PRECAST DECK PANELS FOR STEEL GIRDERS – DETAILS I



PLAN OF TYPICAL UNSTRESSED DECK PANEL
(OPTIONAL, FOR PANEL LENGTHS LESS THAN 1400mm)

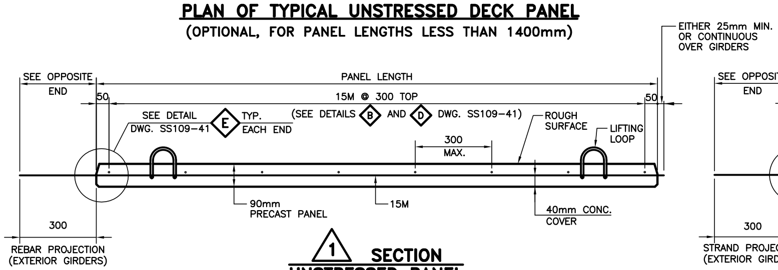


PLAN OF TYPICAL PRESTRESSED DECK PANEL
(ALL PANEL LENGTHS)

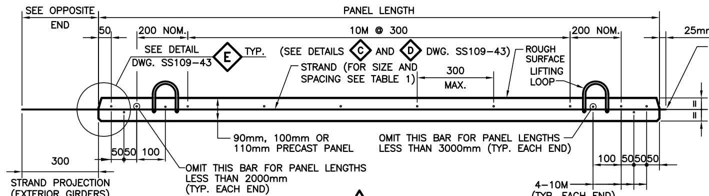


** TERMINATE THE BOTTOM CHAMFER 150mm FROM THE ENDS OF PANEL.

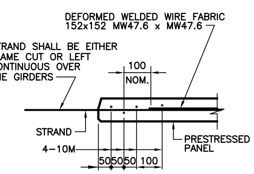
3 SECTION



1 SECTION
UNSTRESSED PANEL



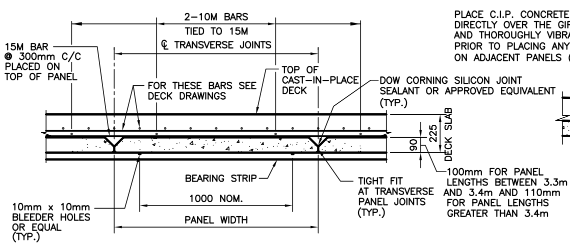
4 SECTION
PRESTRESSED PANEL



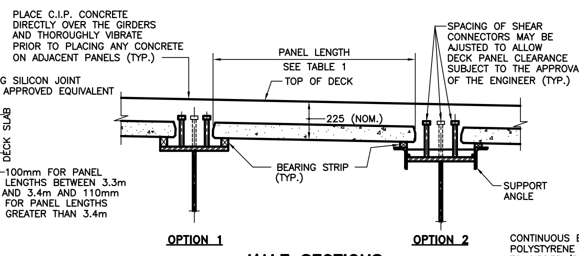
5 SECTION
(ALTERNATE DETAIL WITH WWF)
(PRESTRESSED PANELS ONLY)

TABLE 1

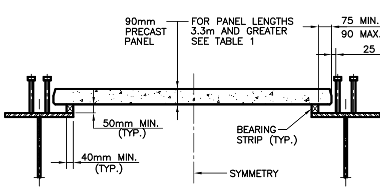
TABLE OF PRESTRESS DATA														
PANEL LENGTH (m)	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8
STRAND DIA. (mm)	9 mm DIA													
STRAND SPACING (mm)	300	300	300	300	275	250	225	175	150	125	100	100	75	75
JACKING FORCE (kN)	77 kN													
BREAKING STRENGTH (kN)	102 kN													
PANEL THICKNESS (mm)	90 mm											100	110 mm	
	SEE SECTION 4 AND DETAILS C AND D													
OPTIONAL	SEE SECTION 1 AND DETAIL B 15M@300c/c													



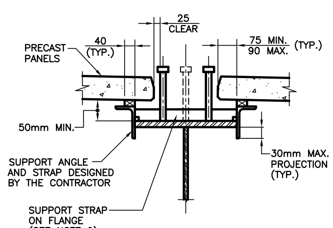
2 SECTION



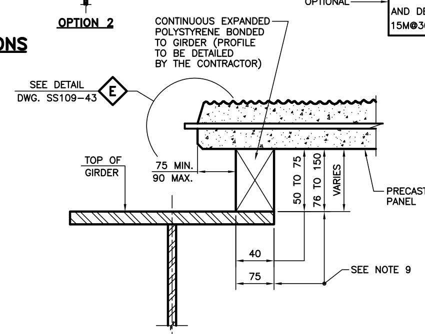
HALF SECTIONS



OPTION 1



OPTION 2: ANGLE SUPPORT DETAIL



OPTION 3
(TEMPORARY BEARING)

NOTES TO DESIGNER:

1. CORROSION PROTECTION (GALVANISED, COATED OR ACR) OF THE SUPPORT ANGLES SHALL MATCH THE CORROSION PROTECTION OF THE STEEL GIRDERS. TO BE SPECIFIED IN THIS STANDARD DRAWING.
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

GENERAL NOTES:

1. THESE DRAWINGS SHOW DETAILS FOR STAY-IN-PLACE PRECAST CONCRETE BRIDGE DECK PANELS FOR USE WITH STEEL GIRDERS.
2. PRECAST DECK PANELS MAY BE USED AS AN ALTERNATIVE TO FALSEWORK.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. SS109-43 AND THE ASSOCIATED SPECIAL PROVISIONS FOR PRECAST PANELS.
4. THE TOTAL COMPOSITE DECK SLAB THICKNESS SHALL BE 225mm.
5. SHOP DRAWINGS SHOWING PANEL LAYOUT AND ASSOCIATED CONSTRUCTION DETAILS SHALL BE PRODUCED BY THE CONTRACTOR.
6. PANELS WITH LENGTHS GREATER THAN 2.5m SHALL BE AT LEAST 30 DAYS OLD BEFORE INSTALLATION.
7. THE BEARING STRIPS THAT ARE USED TO SUPPORT THE PANELS PRIOR TO POURING THE CAST-IN-PLACE TOPPING SHALL BE DETAILED BY THE PRECASTER AND SHALL REMAIN IN PLACE.
8. SUPPORT ANGLES SHALL NOT BE FIELD WELDED TO TOP FLANGES OF STEEL GIRDERS FOR CONTINUOUS MULTI-SPAN GIRDERS BUT MAY BE FIELD WELDED TO TOP FLANGES OF SIMPLY SUPPORTED SINGLE SPAN GIRDERS.
9. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE PANELS DURING CONSTRUCTION.
10. THE LONGITUDINAL REINFORCEMENT PLACED DIRECTLY ON THE PRECAST PANEL SHALL NOT HAVE LAP SPLICES OVER THE TRANSVERSE PANEL JOINTS.

DESIGN CRITERIA:

1. ASSUMED CONSTRUCTION LOADING 2.4 kPa OF DECK SURFACE AREA.
2. THE DECK PANELS ARE DESIGNED AS NON COMPOSITE TO SUPPORT THE DEAD LOAD OF THE PANEL, THE CAST-IN-PLACE CONCRETE TOPPING, 2.4 kPa OF CONSTRUCTION LOADING AND DESIGNED COMPOSITELY TO SUPPORT 90mm OF ASPHALT AND CHBDC TRAFFIC LOADS.
3. PANELS WITH LENGTHS EQUAL TO OR GREATER THAN 1400mm SHALL BE PRESTRESSED.
4. PANELS WITH LENGTHS LESS THAN 1400mm MAY BE UNSTRESSED.
5. SLS DESIGN LIMIT FOR FLEXURAL STRESS FOR PRESTRESSED PANELS IS 2.5 MPa MAXIMUM TENSION AT THE MIDSPAN BOTTOM OF THE PANEL.
6. IF THE CONCRETE STRENGTH OF THE CORRESPONDING CAST IN PLACE DECK IS GREATER THAN 40 MPa, THEN THE STRENGTH OF THE PRECAST PANEL SHALL BE INCREASED TO MATCH.
7. WHEN THE REQUIRED PANEL LENGTH FALLS BETWEEN THOSE VALUES LISTED IN TABLE 1 THEN USE THE STRAND SPACING FOR THE LARGER LISTED PANEL LENGTH.

MATERIALS:

1. **CONCRETE STRENGTHS**

30 MPa AT STRAND RELEASE AND 40 MPa AT 28 DAYS.

2. **PRESTRESSING STEEL**

PRESTRESSING STEEL SHALL BE LOW RELAXATION SEVEN WIRE STRAND. SIZE DESIGNATION 9mm DIA. GRADE 1860 MPa.

3. **REINFORCING STEEL**

REINFORCING STEEL SHALL BE GRADE 400W AND IN ACCORDANCE WITH CAN/CSA STANDARD G30.18-09.

4. **WIRE FABRIC**

DEFORMED WELDED WIRE FABRIC SHALL CONFORM TO CSA G30.15-M1983 (R1991).

STANDARD DRAWING JULY 2014 | SS109-42

PRECAST DECK PANELS FOR STEEL GIRDERS – DETAILS I

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

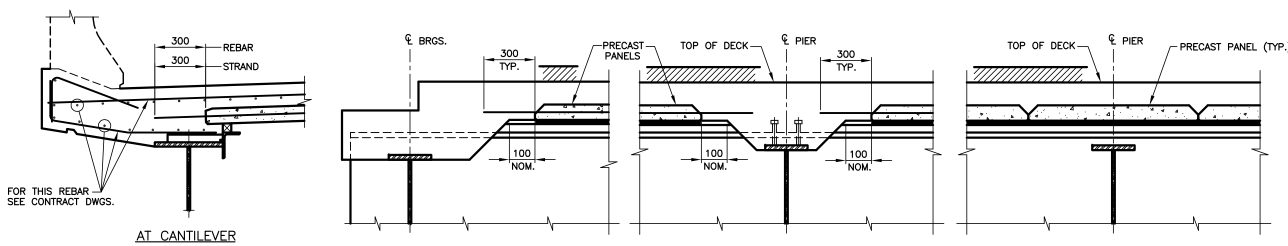
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST	
CONT No	
WP No	SHEET
PRECAST DECK PANELS FOR STEEL GIRDERS – DETAILS II	

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH DWG. SS109-42.
2. THE SHEAR CONNECTOR SPACING ON THE TOP FLANGE OF THE GIRDER SHALL NOT BE LESS THAN 75 mm c/c.



AT CANTILEVER

AT ABUTMENT

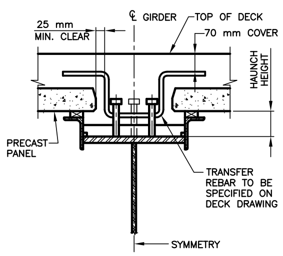
AT PIER

AT PIER

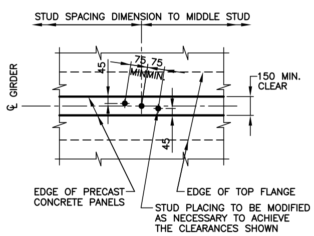
TYPICAL PLACING DETAILS FOR STEEL GIRDERS

NOTE

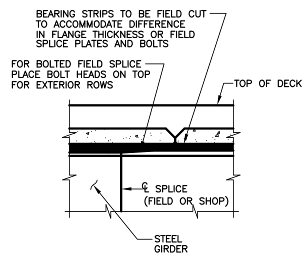
USE TRANSFER REBAR WHEN TOP OF SHEAR STUD IS LESS THAN 25 mm ABOVE TOP OF PANEL OR HAUNCH HEIGHT EXCEEDS 100mm.



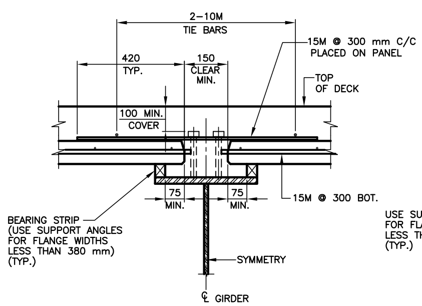
SECTION OF TRANSFER REBAR



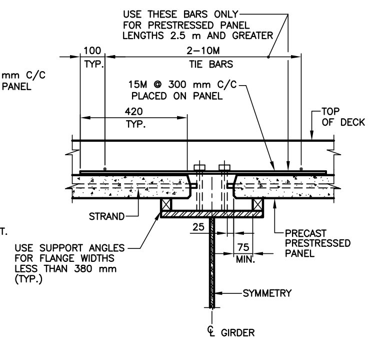
PLAN AT SHEAR STUDS ANCHORS



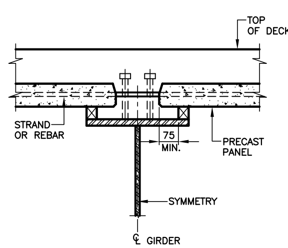
SECTION AT STEEL GIRDER SPLICE
(DIFFERENT FLANGE THICKNESS OR SPLICE PLATES)



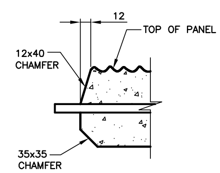
DETAIL B
(UNSTRESSED PANELS)



DETAIL C
(PRESTRESSED PANELS)



DETAIL D
(CONTINUOUS STRAND OR REBAR)



CHAMFER DETAIL E

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING JAN 2013	SS109-43
PRECAST DECK PANELS FOR STEEL GIRDERS – DETAILS II	

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

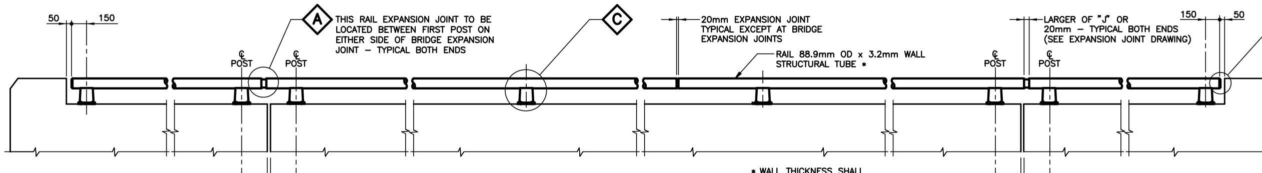
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

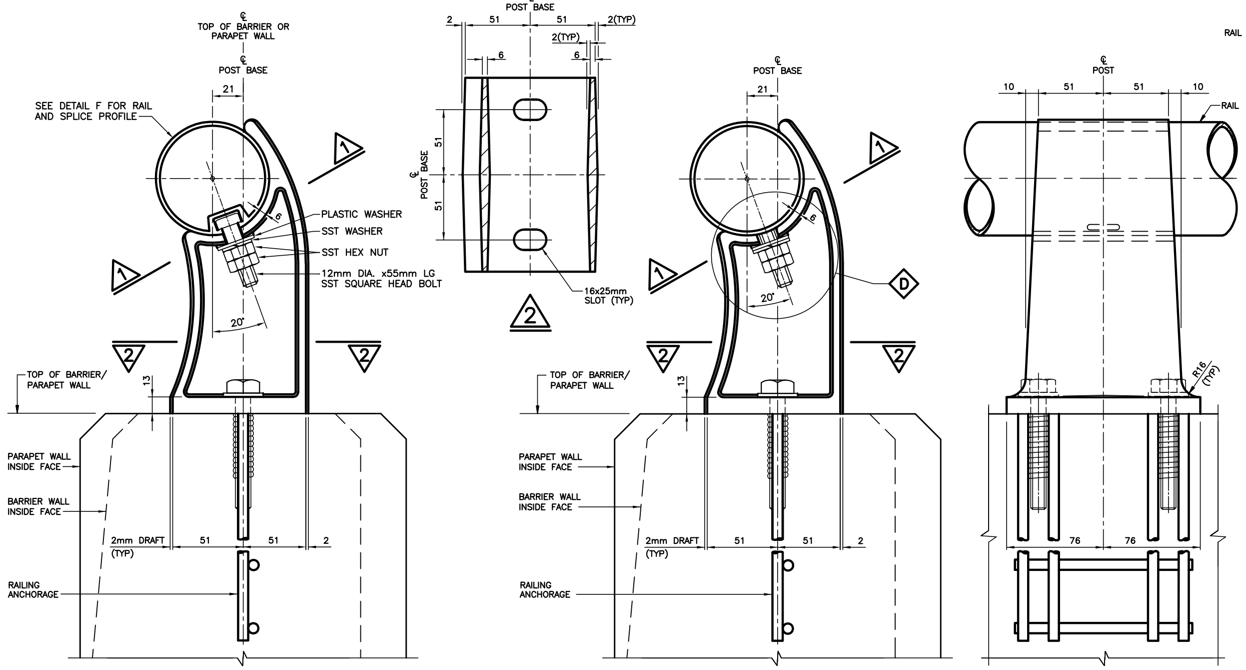
CONT No
WP No

SHEET

RAILING FOR BARRIER/PARAPET WALL



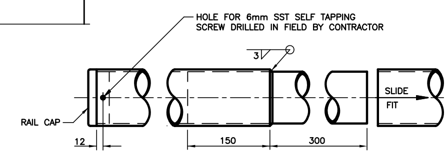
ELEVATION
INSIDE FACE SHOWN



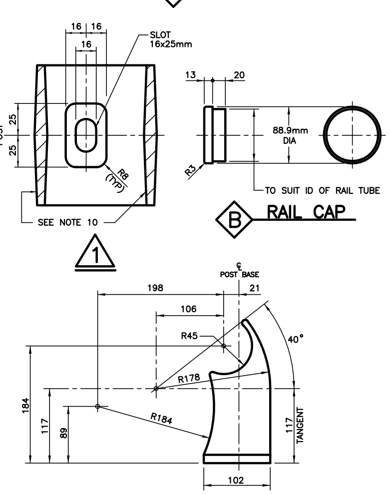
TYPICAL CROSS SECTION ALUMINUM RAIL OPTION

TYPICAL CROSS SECTION STEEL RAIL OPTION

BACK VIEW



DETAIL A



RAIL CAP

POST DETAILS

	MAXIMUM
POST• SPACING FOR STEEL RAIL	3500mm
POST• SPACING FOR ALUMINUM RAIL	2500mm

• POSTS MAY BE STEEL OR ALUMINUM

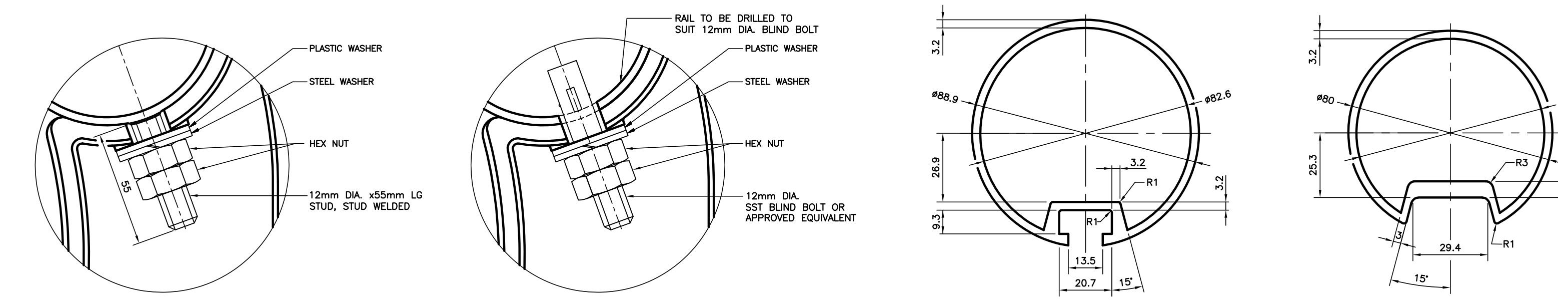
NOTES:
1. ALL NON-STAINLESS STEEL BOLT, NUT AND WASHER FOR FASTENING STEEL RAIL TO POSTS SHALL BE HOT-DIP GALVANIZED.
2. ALL WELDED STUDS OR BLIND BOLTS OR SQUARE HEAD BOLTS SHALL BE INSTALLED AT THE MIDDLE OF THE SLOT AND SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
3. RAILS SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT THIS. IN THIS CASE, THE RAIL LENGTH CAN BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
4. POST AND ANCHORAGES TO INCLUDE ALL BOLTS AND WASHERS.
5. RAILING ANCHORAGE TO BE PLACED PRIOR TO CONCRETING.
6. RAIL SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150m.
7. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE
8. WHERE LAYOUT OF POSTS IS NOT SHOWN, POST LOCATION SHALL BE DETERMINED BY THE CONTRACTOR.
9. WHEN CONNECTING TO EXISTING RAILING, RAIL MUST BE MADE CONTINUOUS AND POST SPACING DETERMINED WITH REFERENCE TO EXISTING POSTS.
10. THE COMBINATION OF STEEL RAIL AND ALUMINUM POSTS IS PERMITTED.
    - –WHEN AN EXTRUDED POST IS USED, THE ALLOY SHALL BE 6061 ALLOY T-6 HEAT TREATED. THE POST DIMENSIONS SHALL NOT BE SMALLER THAN THE DETAILS SHOWN IN THE DRAWING. WALLS OF EXTRUDED POST ARE NOT TAPERED AND SHALL HAVE A UNIFORM THICKNESS OF 8mm MINIMUM.
    - –WHEN A CAST POST IS USED THE ALLOY SHALL BE A444.0-T4.
11. RAIL CAP MATERIAL SHALL BE STEEL OR ALUMINUM. RAIL CAP CAN BE SAND CAST 356 ALUMINUM ALLOY. RAIL CAP TO INCLUDE SST SELF TAPPING FASTENERS.

NOTES FOR STEEL RAIL OPTION:
1. RAIL SHALL BE STRUCTURAL TUBING GRADE 350W.
2. STEEL IN POST SHALL BE CAST STEEL SUPPLIED IN ACCORDANCE WITH ASTM A27/A27M-08 GRADE 65-35.
3. GALVANIZE RAIL TUBING MATING SURFACES TO HAVE A 2 ±0.5mm GAP ALL ROUND TO ENSURE A SLIDE FIT.
4. FULL THREAD STUDS, WASHERS AND NUTS FOR FASTENING RAIL TO POST SHALL CONFORM TO ASTM A108.
5. POSTS AND RAILS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
6. RAIL MAY BE CUT AS REQUIRED IN FIELD WITH PIPE CUTTERS, CUT TO BE REPAIRED AS SPECIFIED IN OPSS 908.

NOTES FOR ALUMINUM RAIL OPTION:
1. ALUMINUM RAIL SHALL BE 6061 ALLOY T-6 HEAT TREATED.
2. STAINLESS STEEL BOLTS, WASHERS AND LOCK NUTS SHALL BE TYPE 304 ACCORDING TO ASTM A314.

LEGEND:
SST – STAINLESS STEEL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.



DETAIL D FULL-THREADED WELDED STUD
(FOR ALTERNATIVE SEE E)

DETAIL E BLIND BOLT

DETAIL F EXTRUDED ALUMINUM RAIL

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

APPLICABLE STANDARD DRAWINGS

OPSD 3419.150 BARRIERS AND RAILINGS – STEEL SINGLE RAILING ANCHORAGE

STANDARD DRAWING MARCH 2015	SS110-21
RAILING FOR BARRIER/PARAPET WALL	

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CHK	CODE CHBDC-06	LOAD	DATE
DRAWN	CHK	SITE		DWG

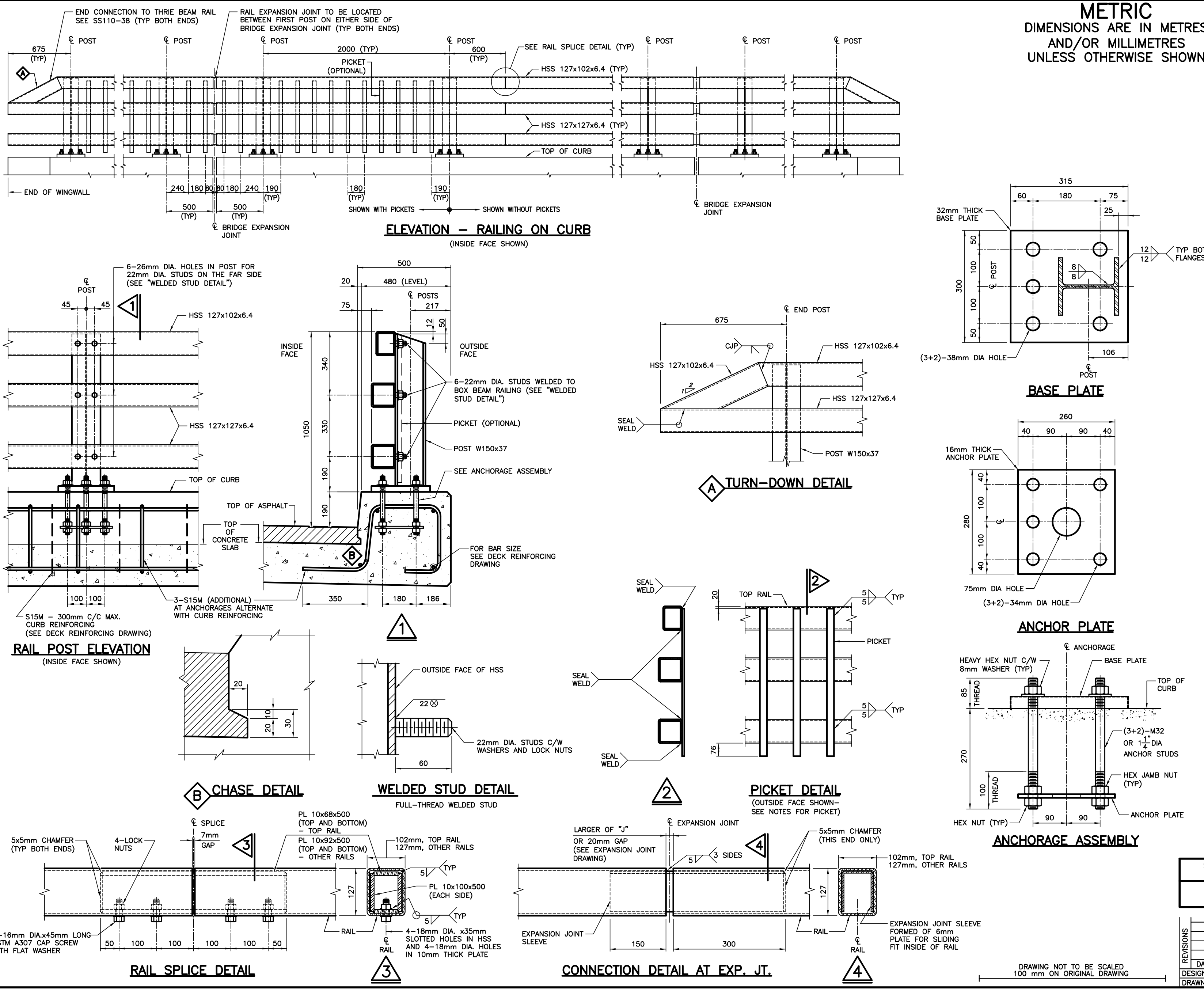
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

THREE TUBE RAILING ON CURB, TL-4



NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF ____ °C.
   (ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V-NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
3. POSTS AND PLATES SHALL BE GRADE 350WT.
4. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 2.
5. ANCHOR STUDS, WASHERS AND NUTS SHALL CONFORM TO ASTM A449.
6. FULL THREAD STUDS, WASHERS AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A108.
7. RAILS SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) RAIL POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
8. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
9. RAILS, POSTS, RAIL SPLICES AND END CAPS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
10. BOLTS, ANCHOR STUDS, PLATES, WASHERS AND NUTS SHALL BE HOT-DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150m.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAILS MAY BE CUT AS REQUIRED IN THE FIELD, CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAILS MUST BE MADE CONTINUOUS AND POST SPACINGS TO BE DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
18. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
19. CHASES ARE REQUIRED ON HIGH AND LOW SIDE OF CROSS FALL.

ADDITIONAL NOTES FOR PICKET:

1. PICKET SHALL BE 38x12 STEEL BAR GRADE 300W.
2. HOT DIP GALVANIZING OF RAILING SHALL BE AFTER ADDITION OF PICKETS.

NOTES TO DESIGNER

1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CSA S6-14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. FOR DECK WITH GFRP REINFORCEMENT, THE EXTRA STAINLESS STEEL BARS SHOWN AT RAIL POST LOCATION SHALL BE REPLACED WITH GFRP REBARS OF EQUIVALENT STRENGTH.
3. PICKETS ARE MANDATORY IF THE RAILING IS ALSO USED TO RETAIN PEDESTRIANS. DESIGNER SHALL INDICATE IF PICKETS SHALL BE USED.
4. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

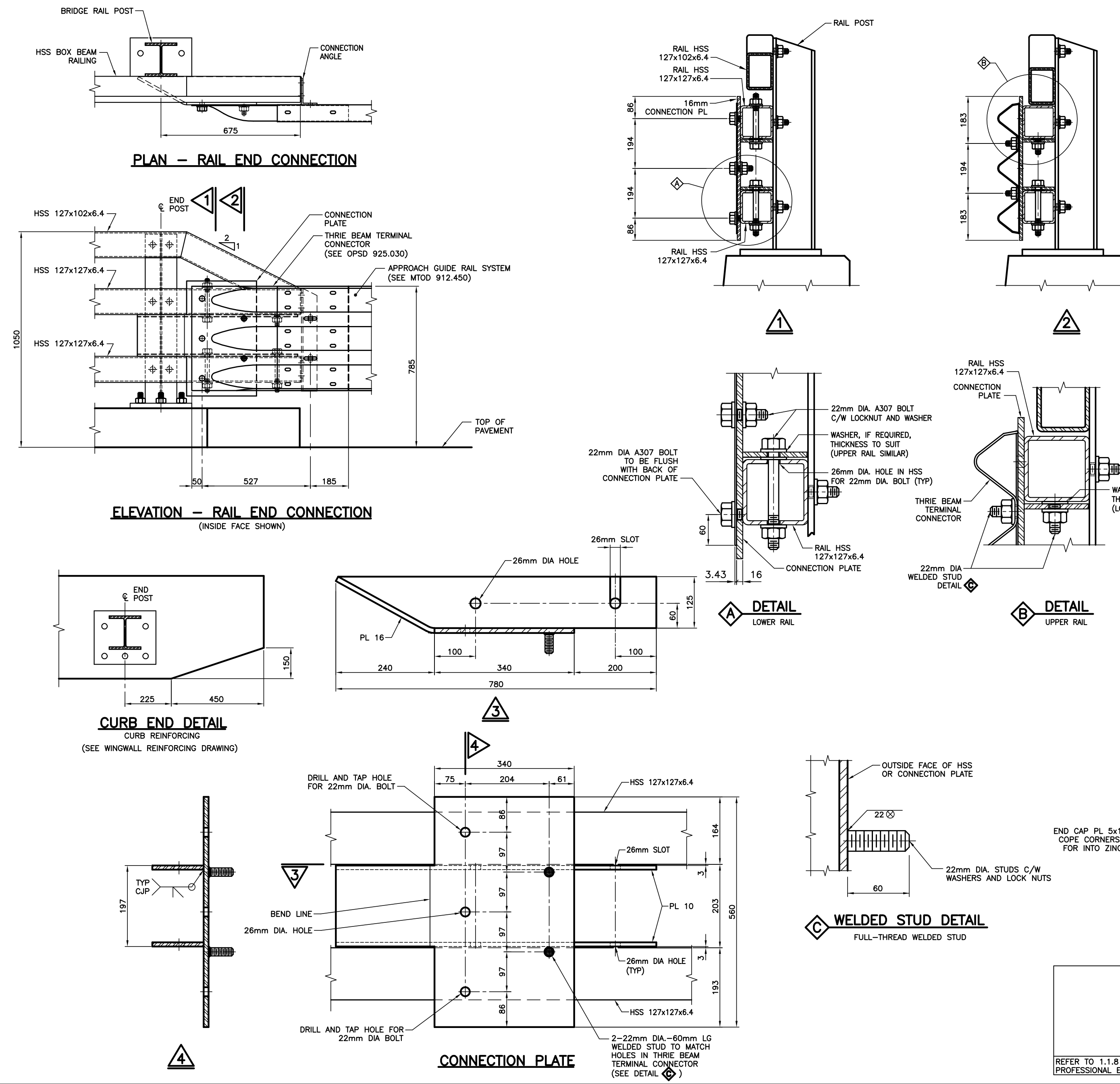
STANDARD DRAWING SEPTEMBER 2016 | SS110-37

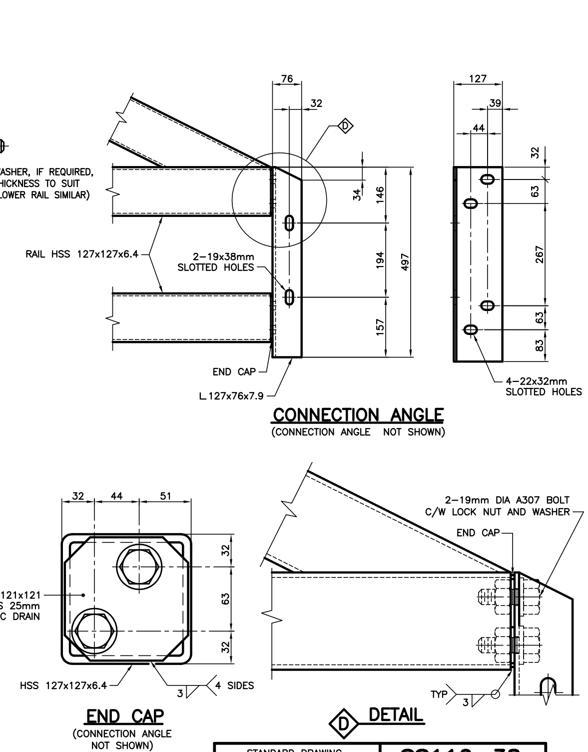
THREE TUBE RAILING ON CURB, TL-4

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG





METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

END CONNECTION FOR THREE TUBE CURB RAILING AND APPROACH RAIL TRANSITION

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH SS110–37.
3. STEEL PLATES SHALL BE GRADE 350W.
4. FULL THREAD STUDS, NUTS, AND WASHERS SHALL CONFORM TO ASTM A108 UNLESS OTHERWISE SPECIFIED.
5. ALL COMPONENTS OF RAILING SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION.
6. BOLTS, PLATES, NUTS AND WASHERS SHALL BE HOT–DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM–B695.
7. DAMAGE TO GALVANIZING SHALL BE REPAIRED WITH A ZINC TOUCH–UP SOLDER, GALVAGUARD OR APPROVED EQUIVALENT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

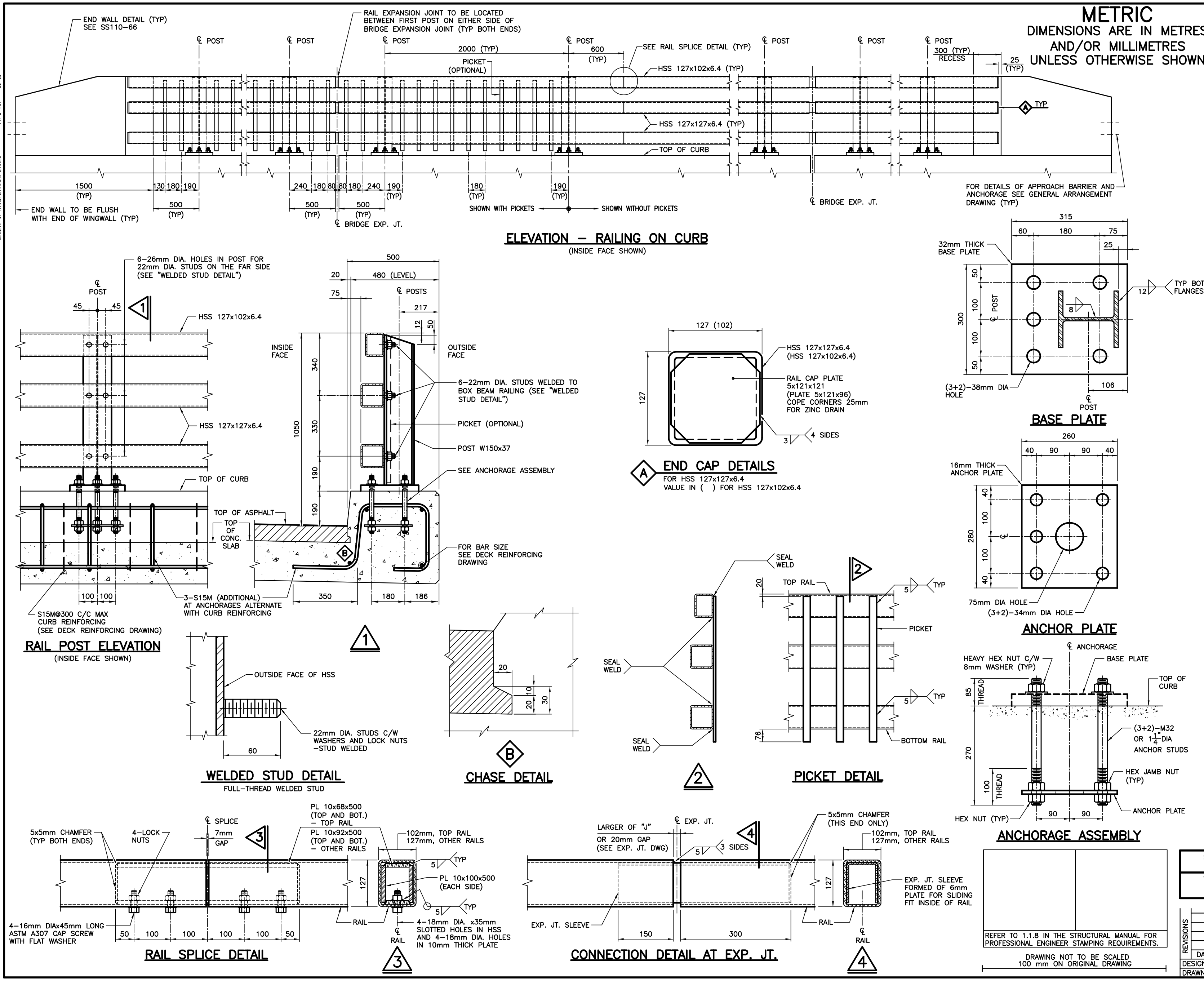
STANDARD DRAWING SEPTEMBER 2016	SS110–38
END CONNECTION FOR THREE TUBE CURB RAILING AND APPROACH RAIL TRANSITION	

REVISIONS

DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH–D–707 88–05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



CONT No	
WP No	
THREE TUBE RAILING ON CURB – TL4 (WITH CONCRETE END WALL)	SHEET

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF ____ °C.
   (ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V-NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
3. POSTS AND PLATES SHALL BE GRADE 350WT.
4. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 2.
5. ANCHOR STUDS, WASHERS AND NUTS SHALL CONFORM TO ASTM A449.
6. FULL THREAD STUDS, WASHERS AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A108.
7. RAILS SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) RAIL POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT THIS. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
8. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
9. RAILS, POSTS, RAIL SPLICES AND END CAPS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
10. BOLTS, ANCHOR STUDS, PLATES, WASHERS AND NUTS SHALL BE HOT-DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150m.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAILS MAY BE CUT AS REQUIRED IN THE FIELD, CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAILS MUST BE MADE CONTINUOUS AND POST SPACINGS TO BE DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. A THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
18. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
19. CHASES ARE REQUIRED ON HIGH AND LOW SIDE OF CROSS FALL.

ADDITIONAL NOTES FOR PICKET:

1. PICKET SHALL BE 38x12 STEEL BAR GRADE 300W.
2. HOT DIP GALVANIZING OF RAILING SHALL BE AFTER ADDITION OF PICKET.

NOTES TO DESIGNER

1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CAN/CSA-S6-14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. FOR DECK WITH GFRP REINFORCEMENT, THE EXTRA STAINLESS STEEL BARS SHOWN AT RAIL POST LOCATION SHALL BE REPLACED WITH GFRP REBARS OF EQUIVALENT STRENGTH.
3. PICKETS ARE MANDATORY IF THE RAILING IS ALSO USED TO PROTECT PEDESTRIANS. DESIGNER SHALL INDICATE IF PICKETS SHALL BE USED.
4. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING MARCH 2016	SS110-39
THREE TUBE RAILING ON CURB – TL4 (WITH CONCRETE END WALL)	

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

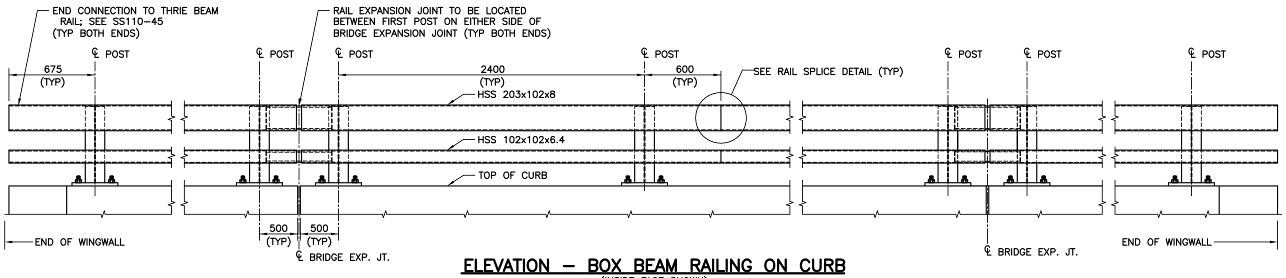
MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

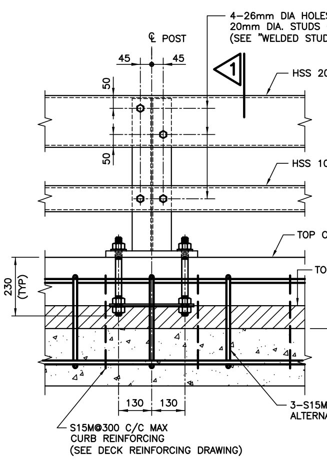
CONT No	
WP No	
	SHEET
TWO TUBE RAILING ON CURB, TL-4	

NOTES TO DESIGNER

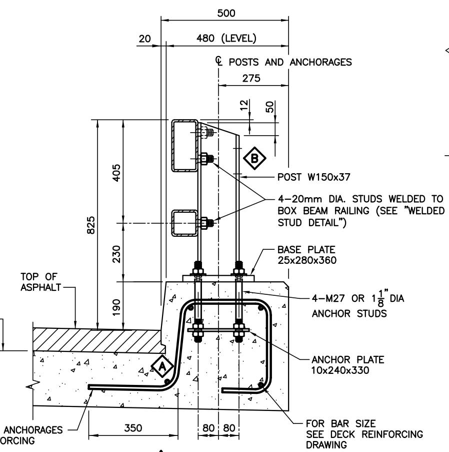
1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CSA S6-14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. FOR DECK WITH GFRP REINFORCEMENT, THE EXTRA STAINLESS STEEL BARS SHOWN AT RAIL POST LOCATION SHALL BE REPLACED WITH GFRP REBARS OF EQUIVALENT STRENGTH
3. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



ELEVATION – BOX BEAM RAILING ON CURB
(INSIDE FACE SHOWN)



RAIL POST ELEVATION
(INSIDE FACE SHOWN)



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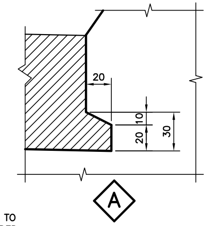
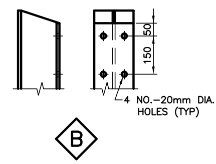
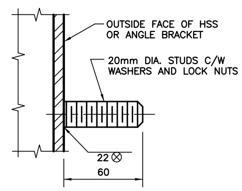
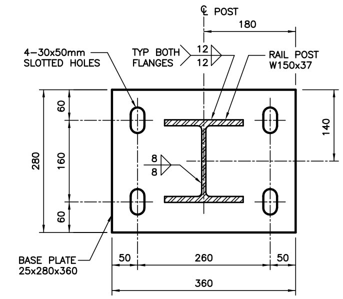


CHASE DETAIL

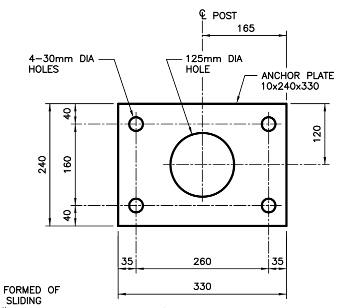




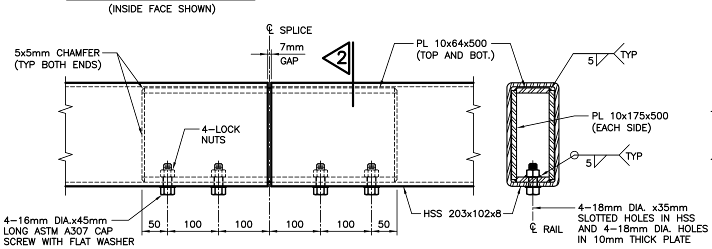
WELDED STUD DETAIL
FULL-THREAD WELDED STUD



BASE PLATE

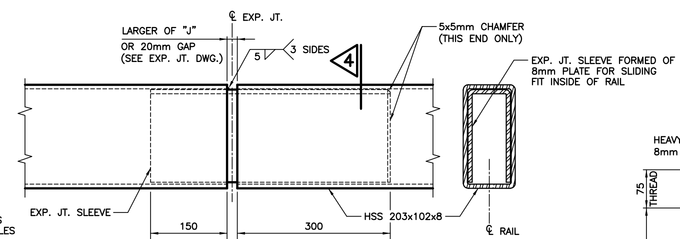


ANCHOR PLATE



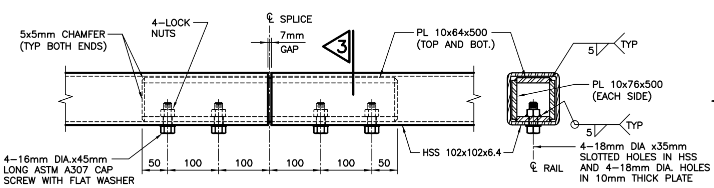
RAIL SPLICE DETAIL
(HSS 203x102x8)

2



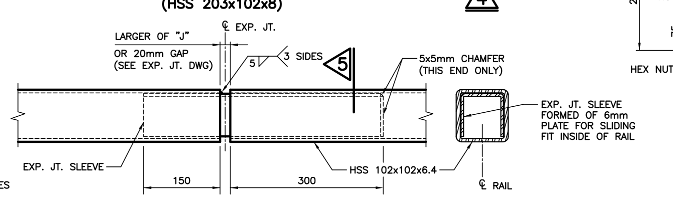
CONNECTION DETAIL AT EXP. JT.
(HSS 203x102x8)

4



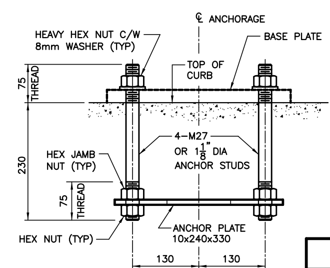
RAIL SPLICE DETAIL
(HSS 102x102x6.4)

3



CONNECTION DETAIL AT EXP. JT.
(HSS 102x102x6.4)

5



ANCHORAGE ASSEMBLY

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF ____ °C.
   (ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V-NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
3. POSTS AND PLATES SHALL BE GRADE 350WT.
4. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 2.
5. ANCHOR STUDS, WASHERS AND NUTS SHALL CONFORM TO ASTM A449.
6. FULL THREAD STUDS, WASHERS AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A108.
7. RAILS SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
8. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
9. RAILS, POSTS, RAIL SPLICES AND END CAPS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
10. BOLTS, ANCHOR STUDS, PLATES, WASHERS AND NUTS SHALL BE HOT-DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150m.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAILS MAY BE CUT AS REQUIRED IN THE FIELD, CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAILS MUST BE MADE CONTINUOUS AND POST SPACINGS TO BE DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
18. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
19. CHASES ARE REQUIRED ON HIGH AND LOW SIDE OF CROSS FALL.

STANDARD DRAWING SEPTEMBER 2016	SS110-44
TWO TUBE RAILING ON CURB, TL-4	

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS					
DATE	BY	DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

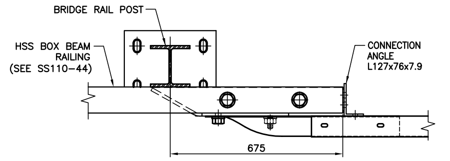
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

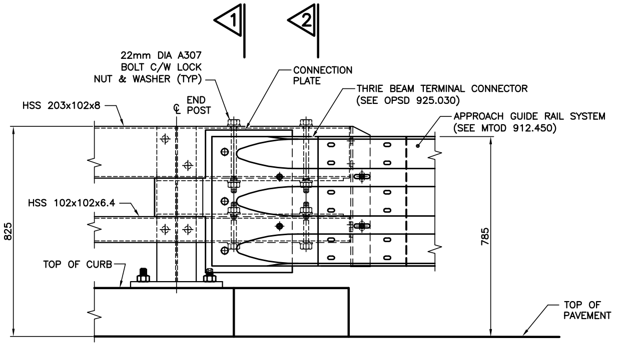
CONT No
WP No

END CONNECTION FOR TWO TUBE CURB RAILING AND APPROACH RAIL TRANSITION

SHEET

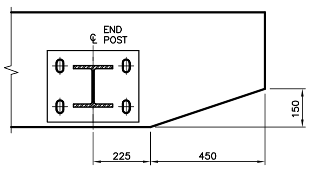


PLAN – RAIL END CONNECTION



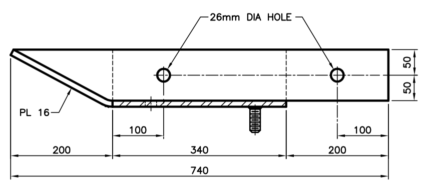
ELEVATION – RAIL END CONNECTION

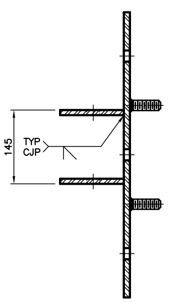
(INSIDE FACE SHOWN)

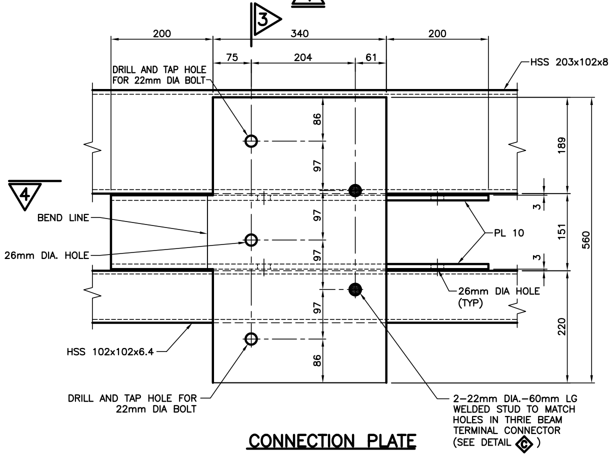


CURB END DETAIL

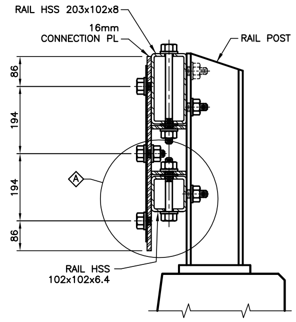
CURB REINFORCING (SEE WINGWALL REINFORCING DRAWING)

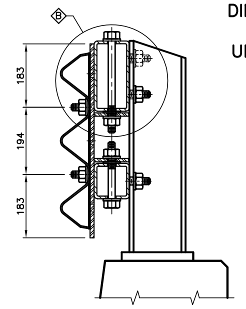


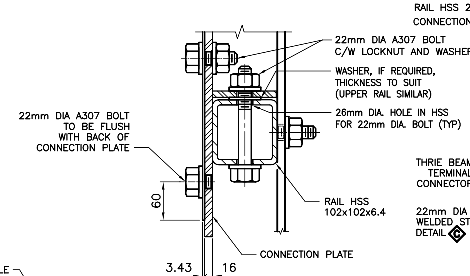




CONNECTION PLATE

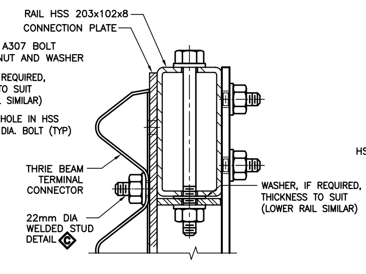






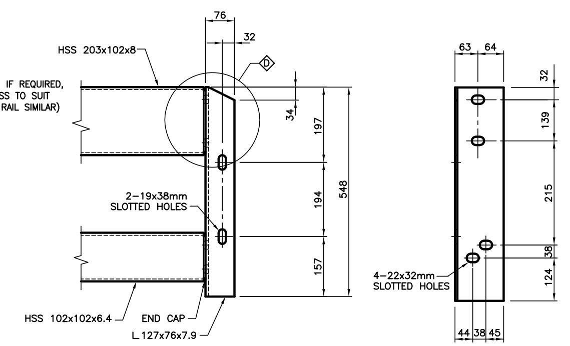
DETAIL A

LOWER RAIL

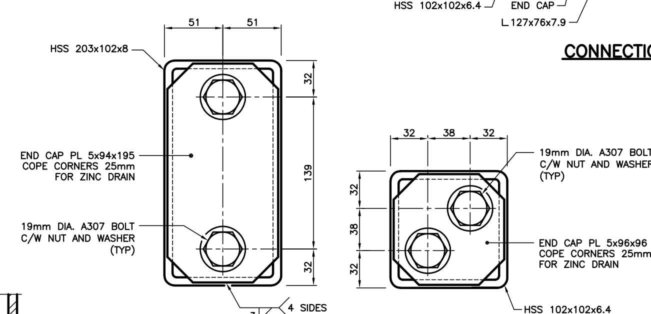


DETAIL B

UPPER RAIL

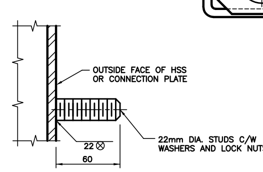


CONNECTION ANGLE



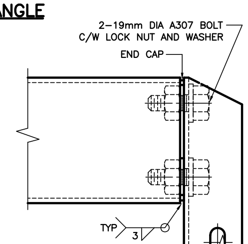
END CAP

CONNECTION ANGLE NOT SHOWN



WELDED STUD DETAIL

FULL-THREAD WELDED STUD



DETAIL D

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH SS110-44.
3. STEEL PLATES SHALL BE GRADE 350W.
4. FULL THREAD STUDS, NUTS, AND WASHERS SHALL CONFORM TO ASTM A108 UNLESS OTHERWISE SPECIFIED.
5. ALL COMPONENTS OF RAILING SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
6. BOLTS, PLATES, NUTS AND WASHERS SHALL BE HOT-DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
7. DAMAGE TO GALVANIZING SHALL BE REPAIRED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR APPROVED EQUIVALENT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016

SS110-45

END CONNECTION FOR TWO TUBE CURB RAILING AND APPROACH RAIL TRANSITION

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD		DATE
DRAWN	CHK	SITE			DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

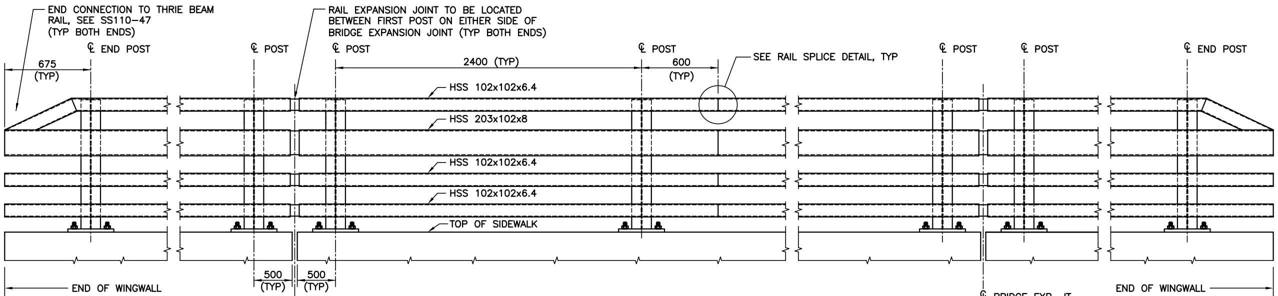
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No	
WP No	
FOUR TUBE RAILING ON SIDEWALK, TL-4	SHEET

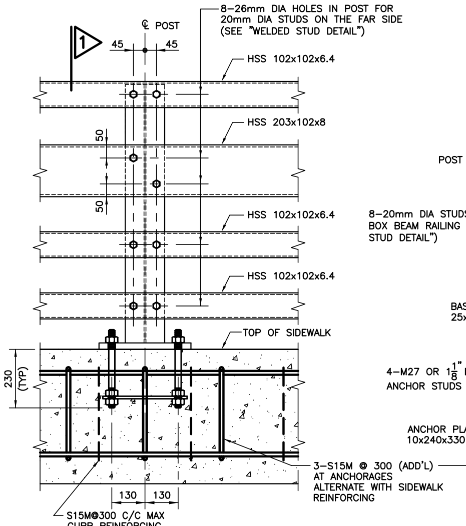
NOTES TO DESIGNER:

1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CSA S6-14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. FOR DECK WITH GFRP REINFORCEMENT, THE EXTRA STAINLESS STEEL BARS SHOWN AT RAIL POST LOCATION SHALL BE REPLACED WITH GFRP REBARS OF EQUIVALENT STRENGTH.
3. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



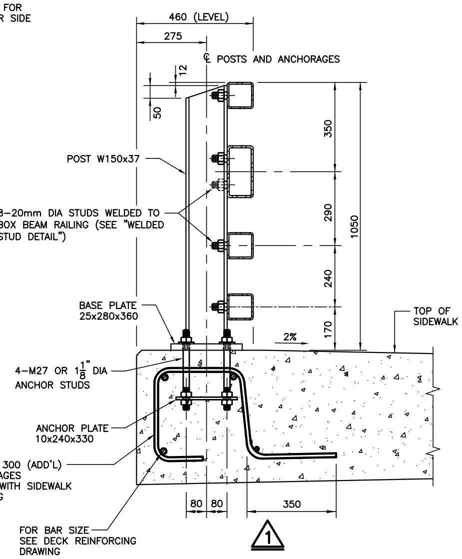
ELEVATION – BOX BEAM RAILING ON SIDEWALK

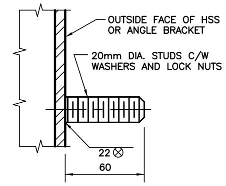
(INSIDE FACE SHOWN)



RAIL POST ELEVATION

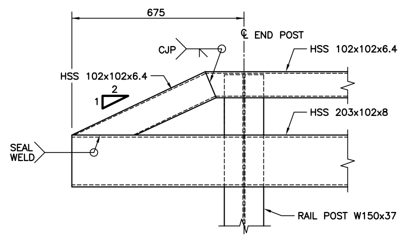
(INSIDE FACE SHOWN)





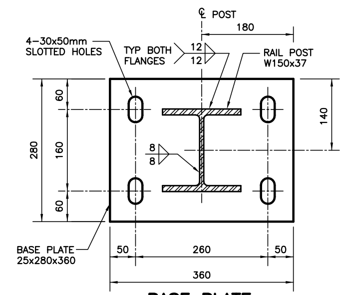
WELDED STUD DETAIL

FULL-THREAD WELDED STUD

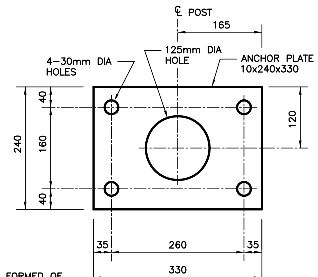


TURN-DOWN DETAIL

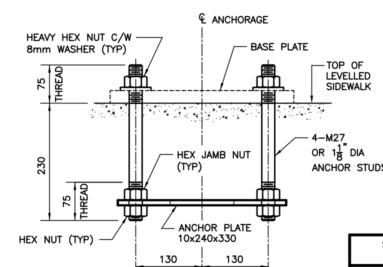
N.T.S.



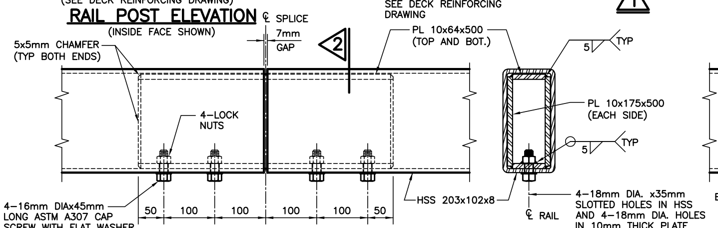
BASE PLATE



ANCHOR PLATE



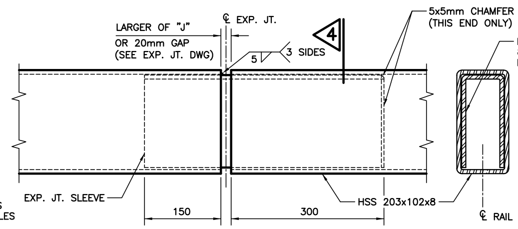
ANCHORAGE ASSEMBLY



RAIL SPLICE DETAIL

(HSS 203x102x8)

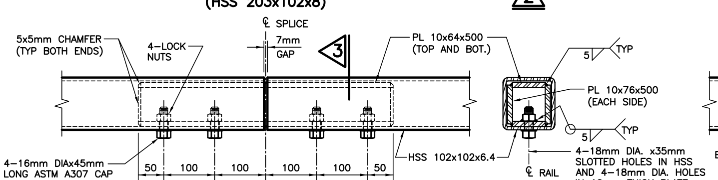
2



CONNECTION DETAIL AT EXP. JT.

(HSS 203x102x8)

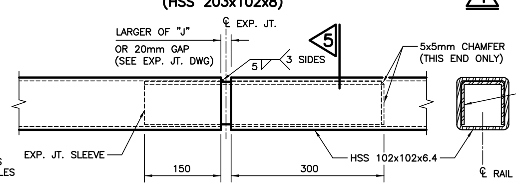
4



RAIL SPLICE DETAIL

(HSS 102x102x6.4)

3



CONNECTION DETAIL AT EXP. JT.

(HSS 102x102x6.4)

5

NOTES:

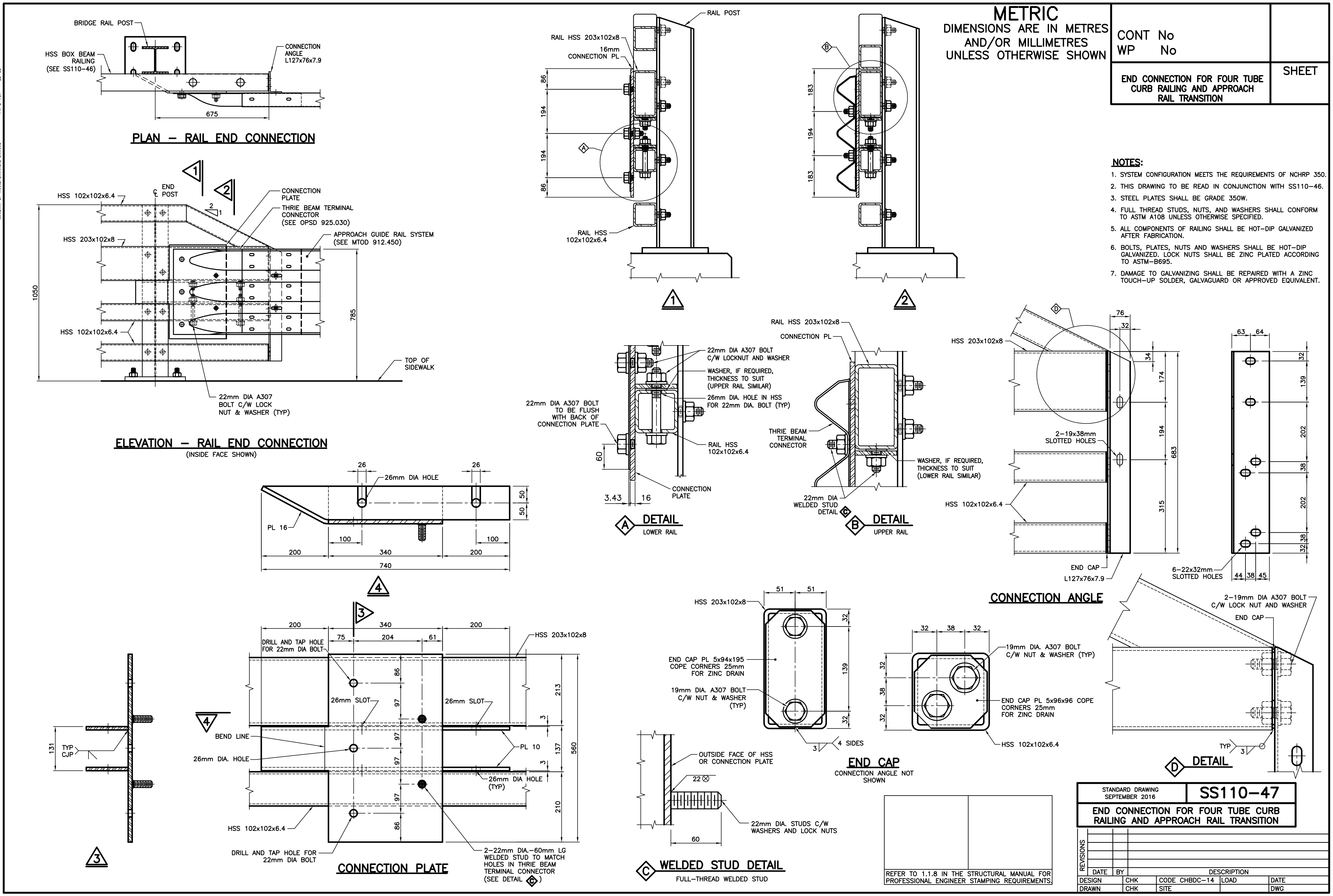
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF ____ °C.
   (ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V-NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
3. POSTS AND PLATES SHALL BE GRADE 350WT.
4. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 2.
5. ANCHOR STUDS, WASHERS, AND NUTS SHALL CONFORM TO ASTM A449.
6. FULL THREAD STUDS, WASHERS, AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A108.
7. RAILS SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
8. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
9. RAILS, POSTS, RAIL SPLICES, AND END CAPS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
10. BOLTS, ANCHOR STUDS, PLATES, WASHERS, AND NUTS SHALL BE HOT-DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150 METRES.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAILS MAY BE CUT AS REQUIRED IN THE FIELD, CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAILS MUST BE MADE CONTINUOUS AND POST SPACINGS TO BE DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
18. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.

STANDARD DRAWING SEPTEMBER 2016	SS110-46
FOUR TUBE RAILING ON SIDEWALK, TL-4	

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14 LOAD	DATE
DRAWN	CHK	SITE	DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05



METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

END CONNECTION FOR FOUR TUBE CURB RAILING AND APPROACH RAIL TRANSITION

SHEET

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH SS110–46.
3. STEEL PLATES SHALL BE GRADE 350W.
4. FULL THREAD STUDS, NUTS, AND WASHERS SHALL CONFORM TO ASTM A108 UNLESS OTHERWISE SPECIFIED.
5. ALL COMPONENTS OF RAILING SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION.
6. BOLTS, PLATES, NUTS AND WASHERS SHALL BE HOT–DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM–B695.
7. DAMAGE TO GALVANIZING SHALL BE REPAIRED WITH A ZINC TOUCH–UP SOLDER, GALVAGUARD OR APPROVED EQUIVALENT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS110–47

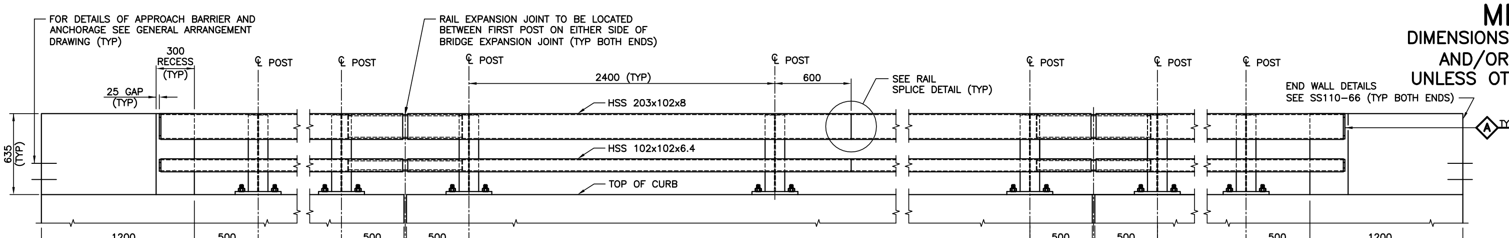
END CONNECTION FOR FOUR TUBE CURB RAILING AND APPROACH RAIL TRANSITION

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC–14	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

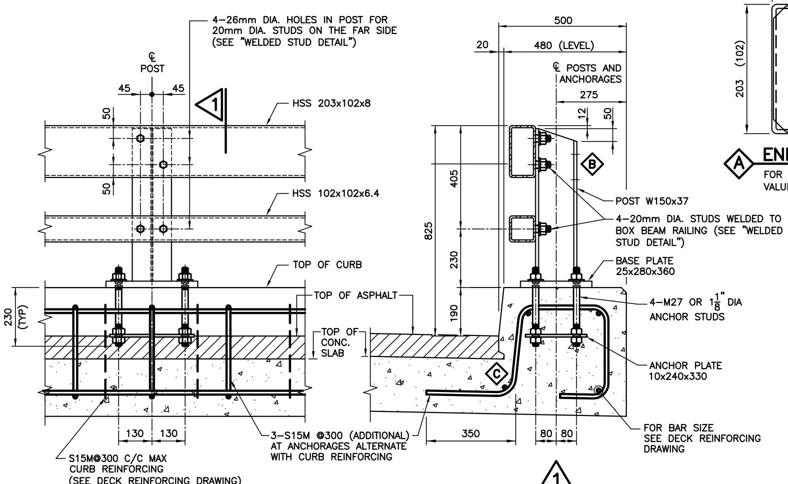
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No	
WP No	
TWO TUBE RAILING ON CURB – TL4 (WITH CONCRETE END WALL)	SHEET

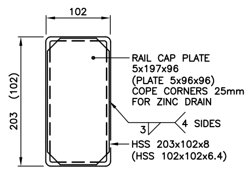


ELEVATION – RAILING ON CURB
(INSIDE FACE SHOWN)

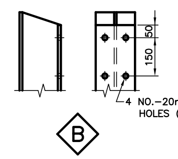


RAIL POST ELEVATION
(INSIDE FACE SHOWN)

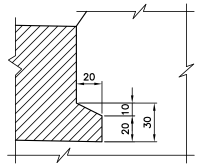
1



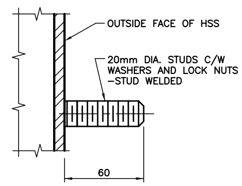
A END CAP DETAILS
FOR HSS 203x102x8
VALUE IN ( ) FOR HSS 102x102x6.4



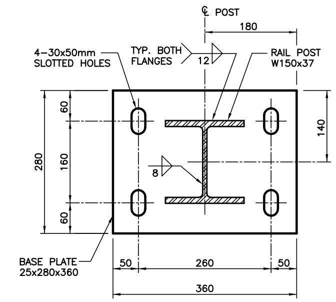
B



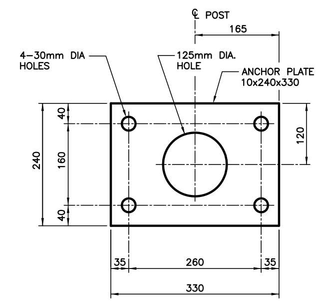
C CHASE DETAIL



WELDED STUD DETAIL
FULL–THREAD WELDED STUD



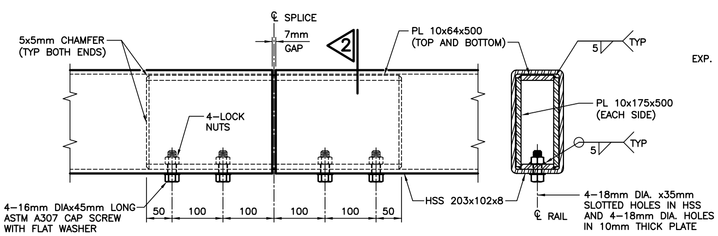
BASE PLATE



ANCHOR PLATE

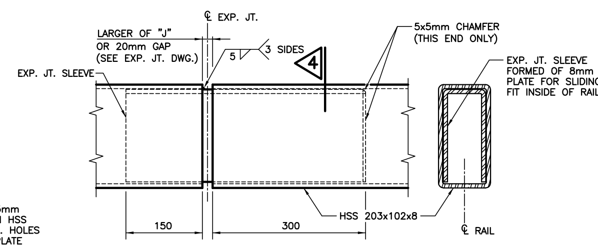
NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V–NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF _____ °C.
(ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V–NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
3. POSTS AND PLATES SHALL BE GRADE 350WT.
4. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 2.
5. ANCHOR STUDS, WASHERS, AND NUTS SHALL CONFORM TO ASTM A449.
6. FULL THREAD STUDS, WASHERS, AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A108.
7. RAIL SHALL BE SUPPLIED IN LENGTH TO BE ATTACHED TO A MINIMUM OF THREE (3) RAIL POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINT DOES NOT PERMIT THIS. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
8. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
9. RAILS, POSTS, RAIL SPLICES, AND END CAPS SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION.
10. BOLTS, ANCHOR STUDS, PLATES, WASHERS, AND NUTS SHALL BE HOT–DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM–B695.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150m.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAILS MAY BE CUT AS REQUIRED IN THE FIELD, CUT TO BE SURFACE TREATED WITH A ZINC TOUCH–UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAILS MUST BE MADE CONTINUOUS AND POST SPACINGS TO BE DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
18. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.
19. CHASES ARE REQUIRED ON HIGH AND LOW SIDE OF CROSS FALL.



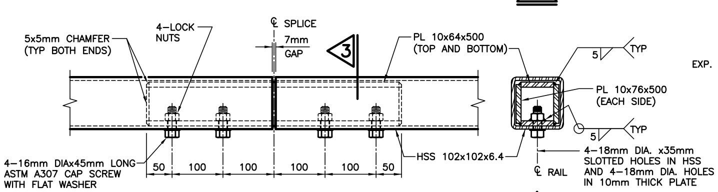
RAIL SPLICE DETAIL
(HSS 203x102x8)

2



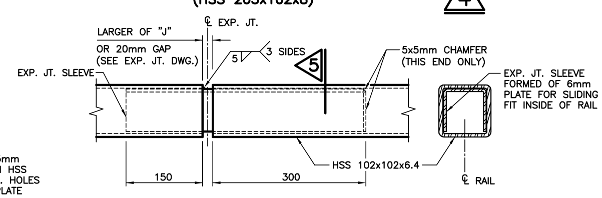
CONNECTION DETAIL AT EXP. JT.
(HSS 203x102x8)

4



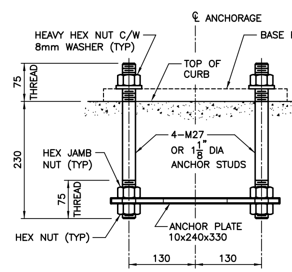
RAIL SPLICE DETAIL
(HSS 102x102x6.4)

3



CONNECTION DETAIL AT EXP. JT.
(HSS 102x102x6.4)

5



ANCHORAGE ASSEMBLY

NOTES TO DESIGNER

1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CAN/CSA–S6–14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. FOR DECK WITH GFRP REINFORCEMENT, THE EXTRA STAINLESS STEEL BARS SHOWN AT RAIL POST LOCATION SHALL BE REPLACED WITH GFRP REBARS OF EQUIVALENT STRENGTH.
3. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

STANDARD DRAWING MARCH 2016	SS110–48
TWO TUBE RAILING ON CURB – TL4 (WITH CONCRETE END WALL)	

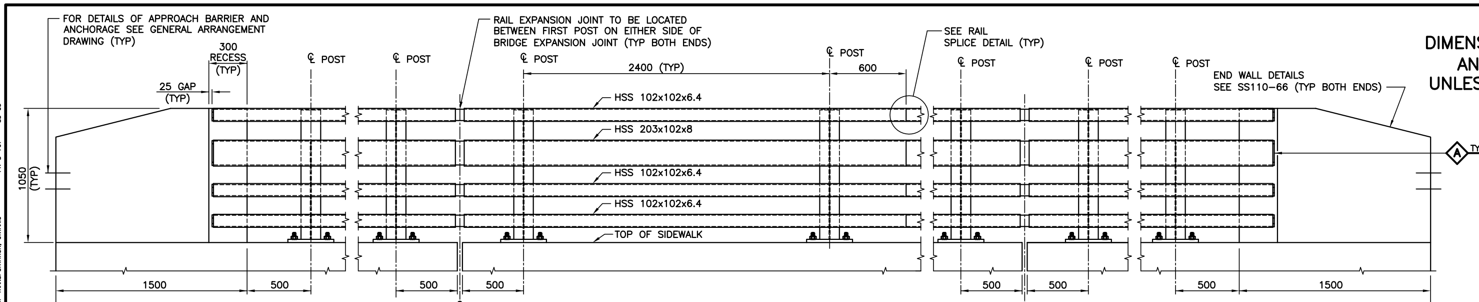
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	CHK	CODE CHBDC–14 LOAD	DATE
DRAWN	CHK	SITE	DWG

METRIC

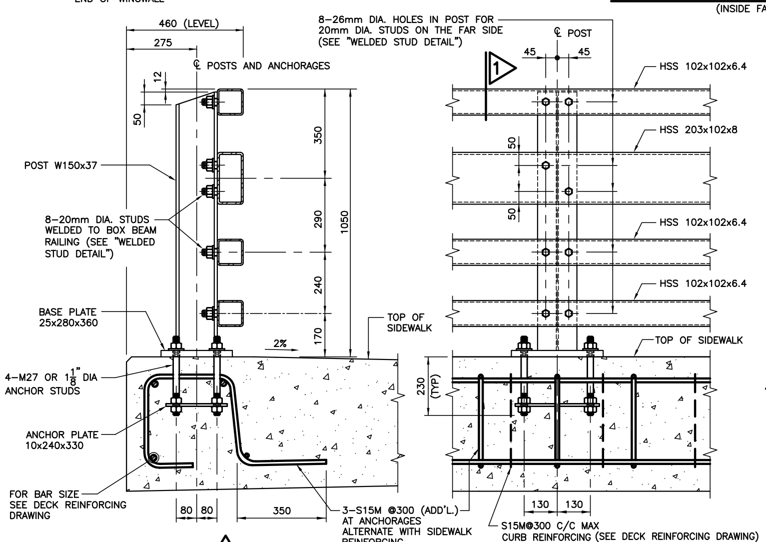
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No WP No	
FOUR TUBE RAILING ON SIDEWALK– TL4 (WITH CONCRETE END WALL)	SHEET



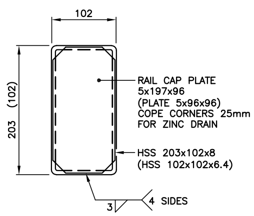
ELEVATION – RAILING ON SIDEWALK

(INSIDE FACE SHOWN)



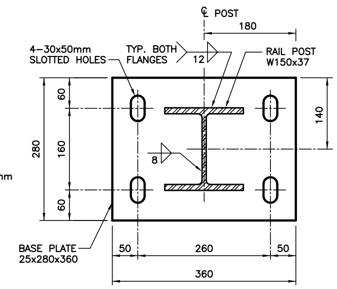
RAIL POST ELEVATION

(INSIDE FACE SHOWN)

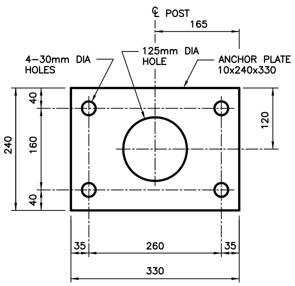


A END CAP DETAILS

FOR HSS 203x102x8
VALUE IN ( ) FOR HSS 102x102x6.4



BASE PLATE



ANCHOR PLATE

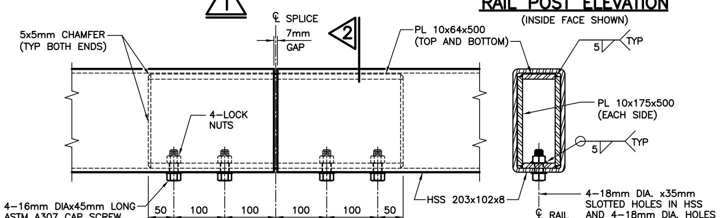
NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V–NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF ____ °C.

   (ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V–NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
3. POSTS AND PLATES SHALL BE GRADE 350WT.
4. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 2.
5. ANCHOR STUDS, WASHERS AND NUTS SHALL CONFORM TO ASTM A449.
6. FULL THREAD STUDS, WASHERS AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A108.
7. RAIL SHALL BE SUPPLIED IN LENGTH TO BE ATTACHED TO A MINIMUM OF THREE (3) RAIL POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINT DOES NOT PERMIT THIS. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
8. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
9. RAILS, POSTS, RAIL SPLICES, AND END CAPS SHALL BE HOT–DIP GALVANIZED AFTER FABRICATION.
10. BOLTS, ANCHOR STUDS, PLATES, WASHERS AND NUTS SHALL BE HOT–DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM–B695.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150 METRES.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAILS MAY BE CUT AS REQUIRED IN THE FIELD, CUT TO BE SURFACE TREATED WITH A ZINC TOUCH–UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAILS MUST BE MADE CONTINUOUS AND POST SPACINGS TO BE DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
18. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA.

NOTES TO DESIGNER

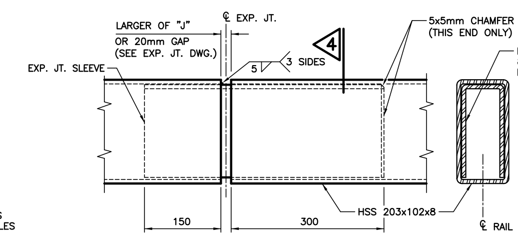
1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CAN/CSA–S6–14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. FOR DECK WITH GFRP REINFORCEMENT, THE EXTRA STAINLESS STEEL BARS SHOWN AT RAIL POST LOCATION SHALL BE REPLACED WITH GFRP REBARS OF EQUIVALENT STRENGTH.
3. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



RAIL SPLICE DETAIL

(HSS 203x102x8)

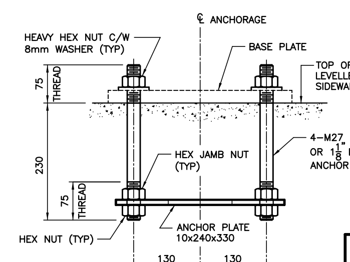
2



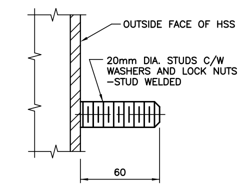
CONNECTION DETAIL AT EXP. JT.

(HSS 203x102x8)

4



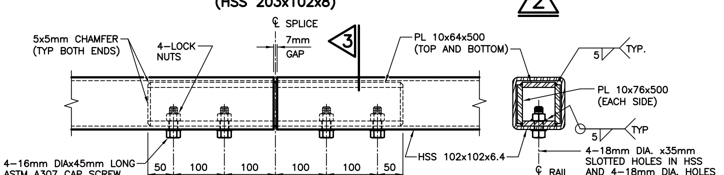
ANCHORAGE ASSEMBLY



WELDED STUD DETAIL

FULL–THREAD WELDED STUD

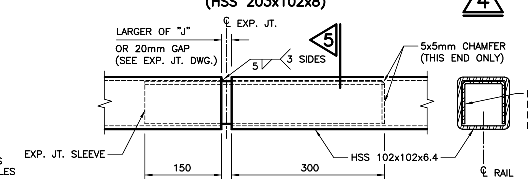
N.T.S.



RAIL SPLICE DETAIL

(HSS 102x102x6.4)

3



CONNECTION DETAIL AT EXP. JT.

(HSS 102x102x6.4)

5

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING MARCH 2016	SS110–49
FOUR TUBE RAILING ON SIDEWALK – TL4 (WITH CONCRETE END WALL)	

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CHK	CODE CHBDC–14	LOAD		DATE
DRAWN	CHK	SITE			DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH–D–707 88–05

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

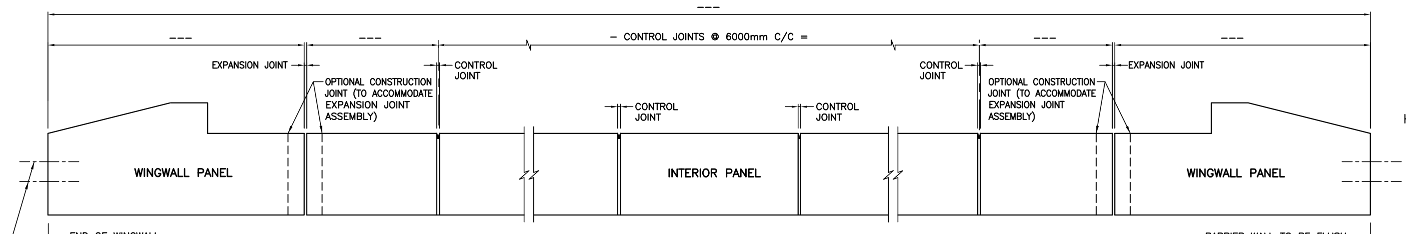
DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

CONT No

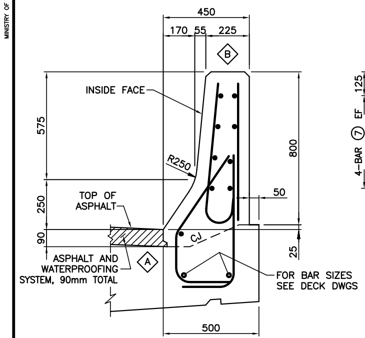
WP No

SHEET

BARRIER WALL WITH RAILING, TL-4 (STAINLESS STEEL REBAR)

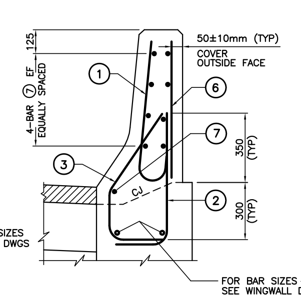


ELEVATION



1 BARRIER WALL ON DECK

TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)



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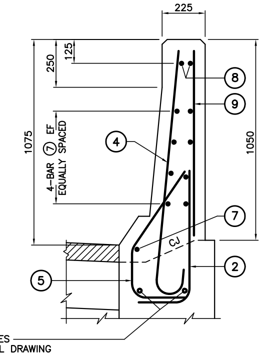
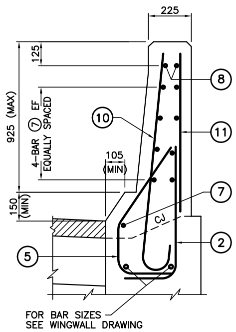
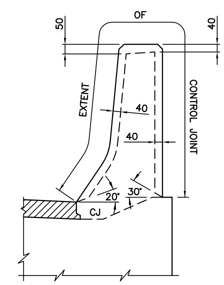


3 BARRIER WALL ON WINGWALL

TYPICAL REINFORCING



4

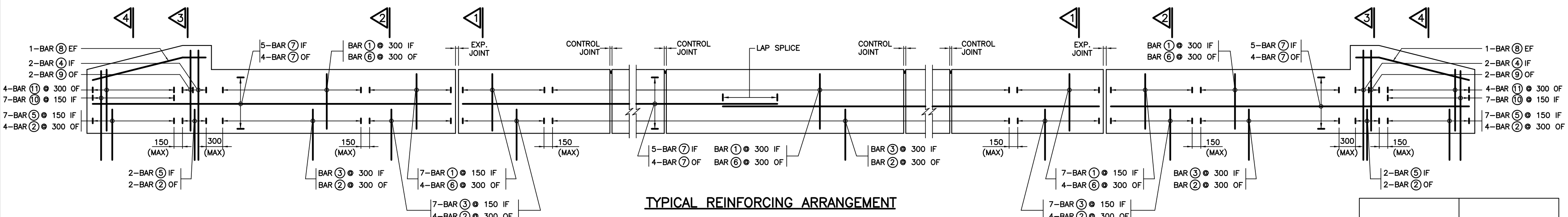


EXTENT OF CONTROL JOINT IN BARRIER WALL

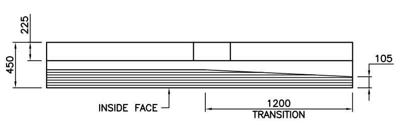
BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 670
2	S10M	260, 650
3	S15M	280, 250, 500, 275
4	S15M	130, 65, 1170
5	S15M	250, 240, 530, 300
6	S10M	STRAIGHT
7	S15M	STRAIGHT
8	S15M	240, 970, 240
9	S10M	STRAIGHT
10	S15M	130, 65, VARIES
11	S10M	STRAIGHT, LENGTH VARIES

NOTES:

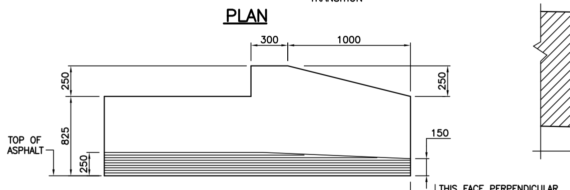
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. LEGEND:
    - EF – DENOTES EACH FACE
    - IF – DENOTES INSIDE FACE
    - OF – DENOTES OUTSIDE FACE
    - CJ – CONSTRUCTION JOINT



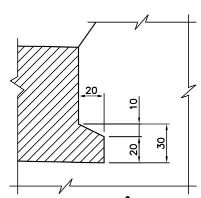
TYPICAL REINFORCING ARRANGEMENT



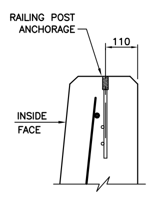
PLAN



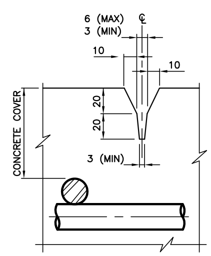
ELEVATION OF BARRIER WALL ON WINGWALL



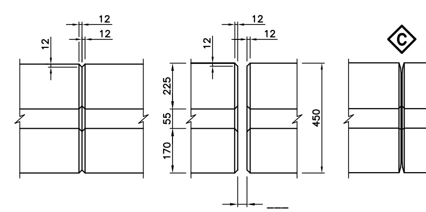
A CHASE DETAIL



B POST ANCHORAGE DETAIL



C CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

C TYPICAL CONTROL JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:

SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016

SS110-54

BARRIER WALL WITH RAILING, TL-4 (STAINLESS STEEL REBAR)

REVISIONS

DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

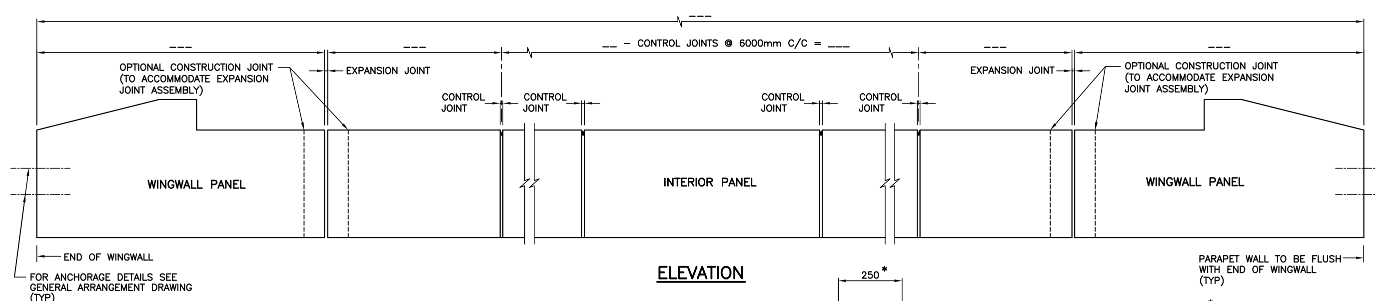
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

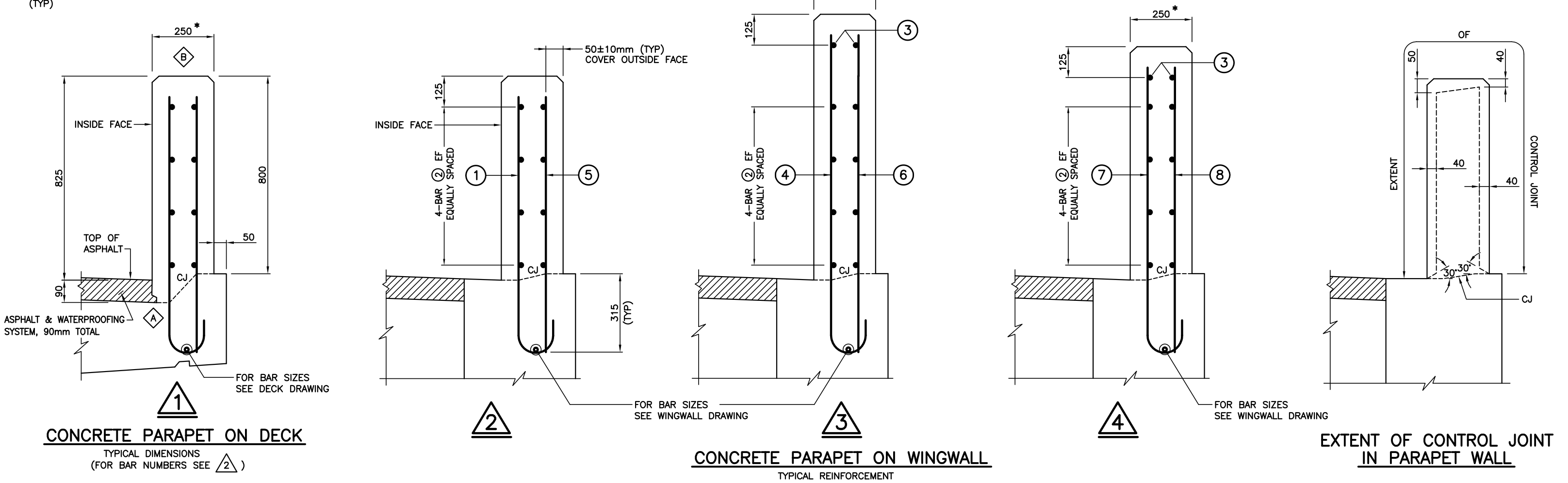
CONT No
WP No

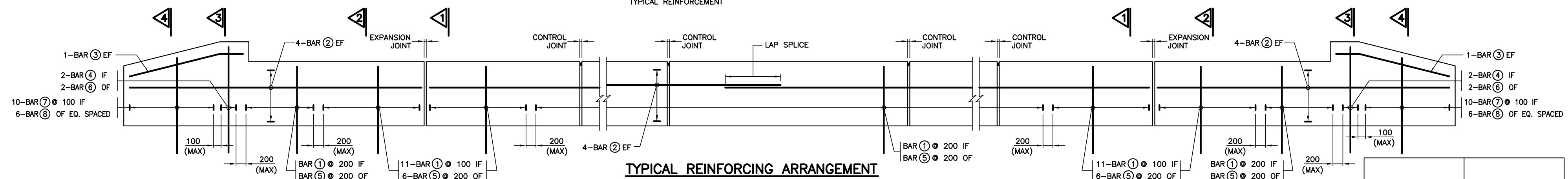
SHEET

PARAPET WALL WITH RAILING, TL-4
(STAINLESS STEEL REBAR)

* NOTE TO DESIGNER
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.



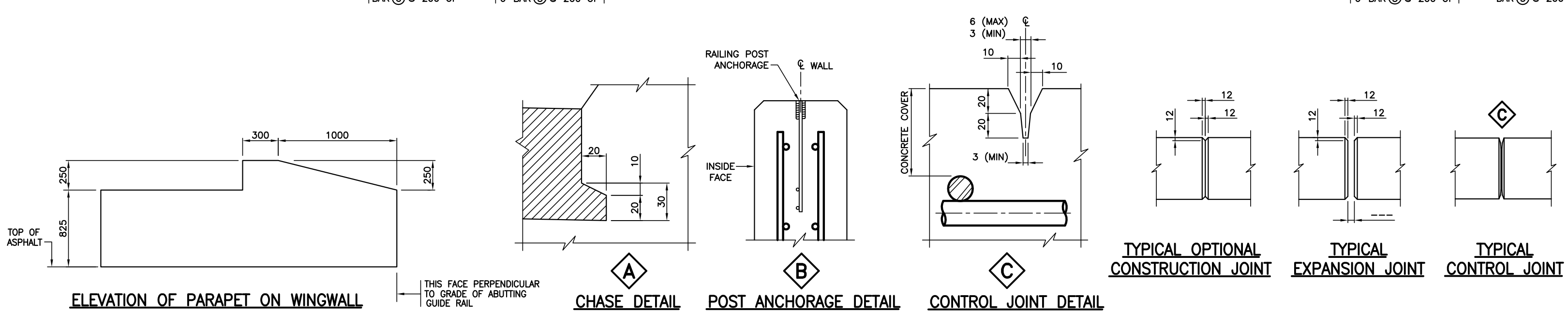




NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING STEEL 60 ±10mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 965
2	S15M	STRAIGHT
3	S15M	240, 970, 240
4	S15M	130, 65, 1215
5	S10M	STRAIGHT
6	S10M	STRAIGHT
7	S15M	130, 65, VARIES
8	S10M	STRAIGHT, LENGTH VARIES



REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING
SEPTEMBER 2016

SS110-56

PARAPET WALL WITH RAILING, TL-4
(STAINLESS STEEL REBAR)

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

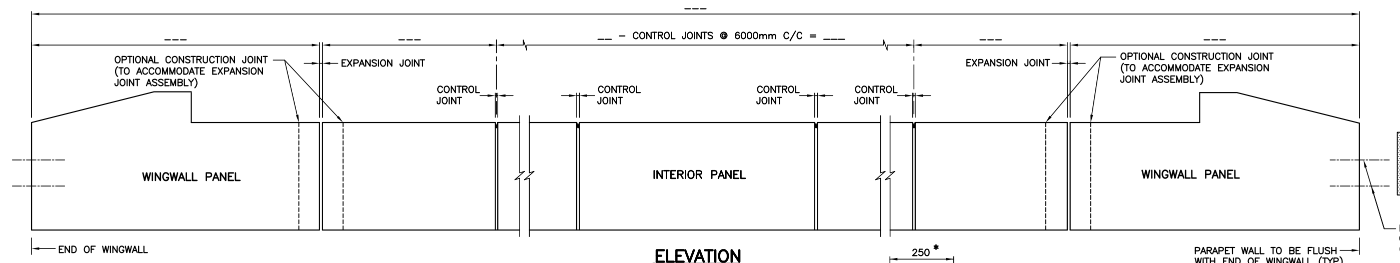
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

CONT No	
WP No	SHEET

PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (STAINLESS STEEL REBAR)

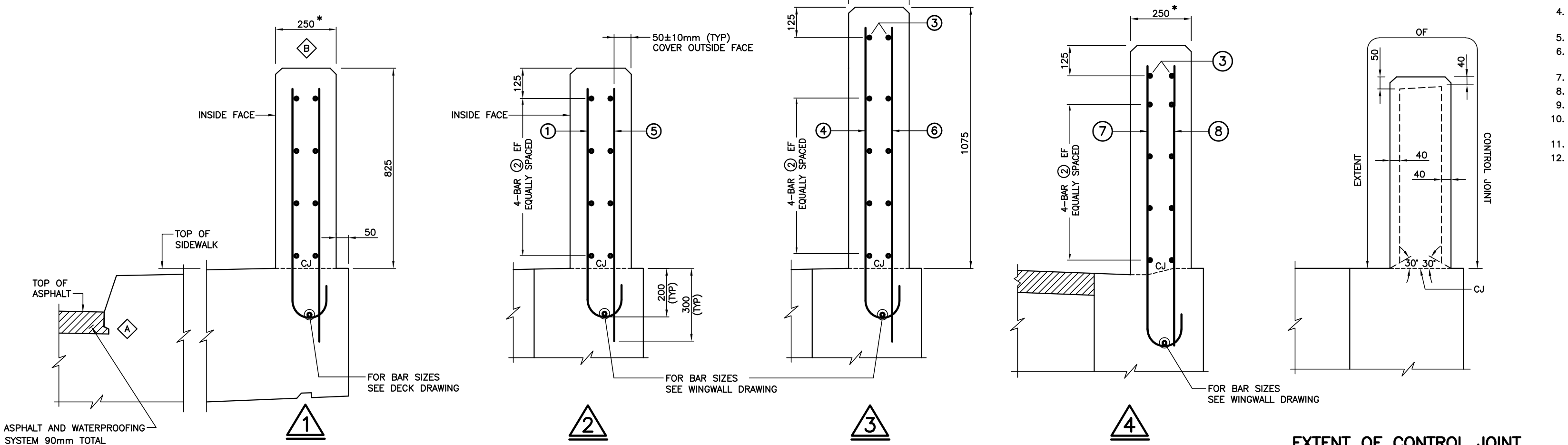


ELEVATION

*** NOTE TO DESIGNER**
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING STEEL 60 ±10mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

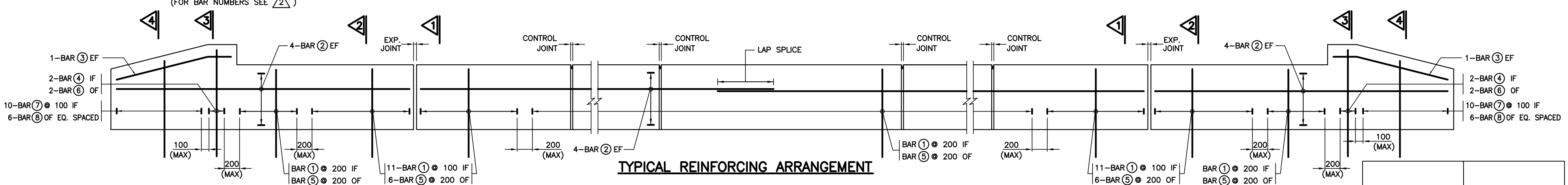


CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCEMENT

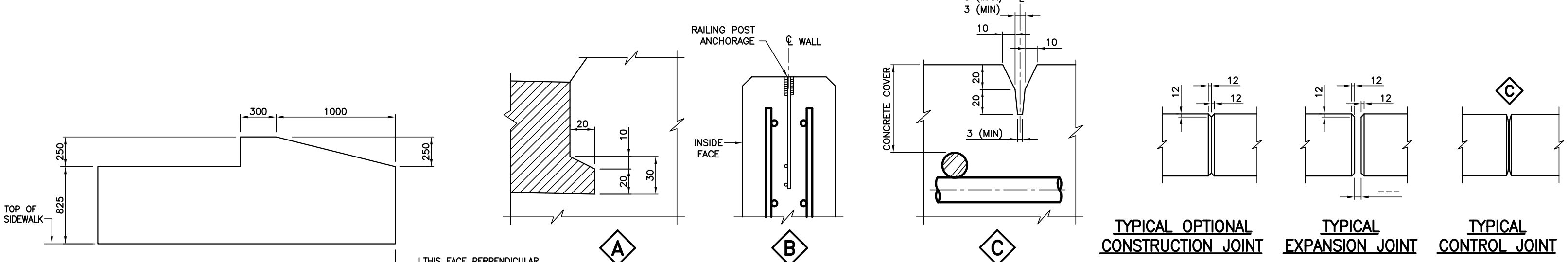
EXTENT OF CONTROL JOINT IN PARAPET WALL

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 875
2	S15M	STRAIGHT
3	S15M	240, 970, 240
4	S15M	130, 65, 1125
5	S10M	STRAIGHT
6	S10M	STRAIGHT
7	S15M	130, 65, VARIES
8	S10M	STRAIGHT, LENGTH VARIES



TYPICAL REINFORCING ARRANGEMENT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.



ELEVATION OF PARAPET ON WINGWALL

CHASE DETAIL

POST ANCHORAGE DETAIL

CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

APPLICABLE STANDARD DRAWINGS

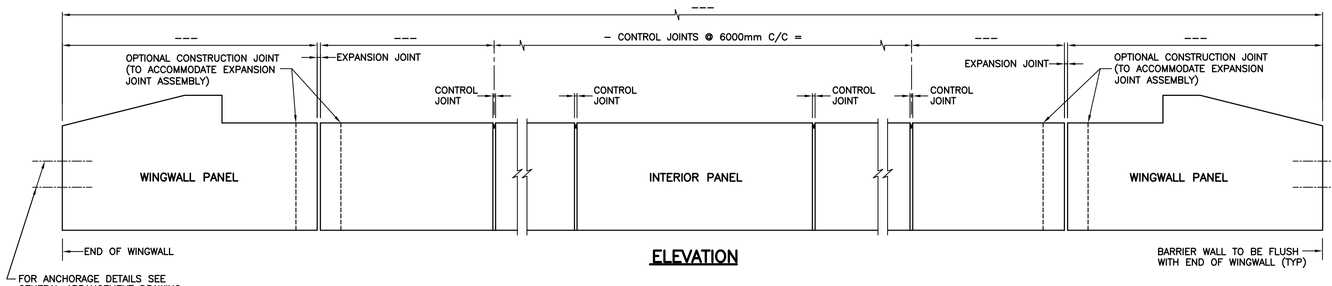
SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016 — **SS110-57**

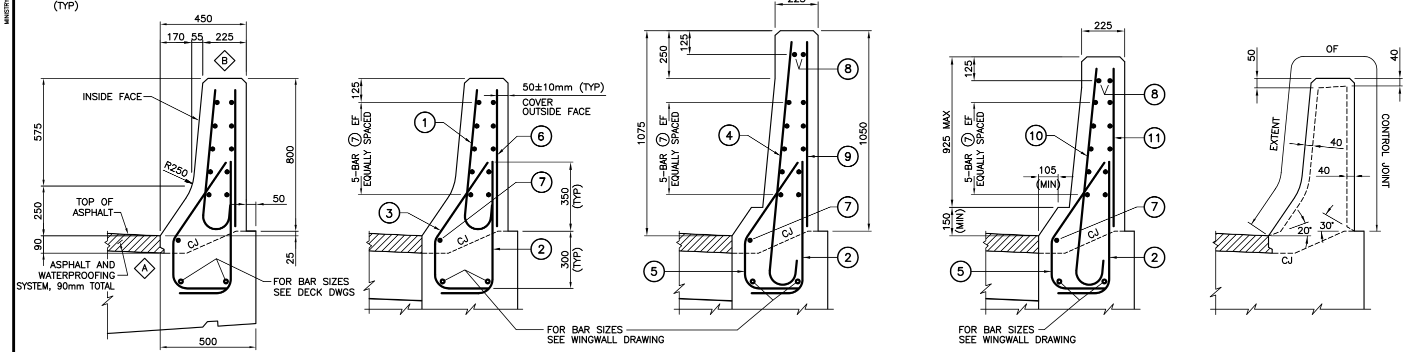
PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (STAINLESS STEEL REBAR)

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



ELEVATION



1 BARRIER WALL ON DECK
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

2

3 BARRIER WALL ON WINGWALL
TYPICAL REINFORCING

4

EXTENT OF CONTROL JOINT IN BARRIER WALL

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONT No
WP No

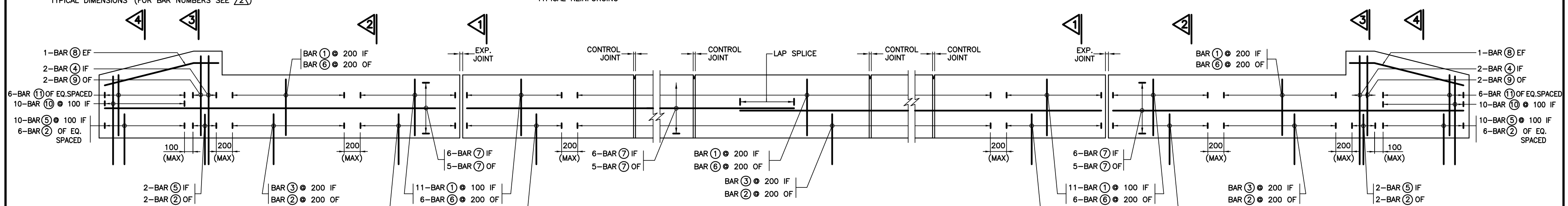
SHEET

BARRIER WALL WITH RAILING, TL–4 (GFRP REBAR)

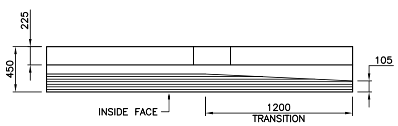
BAR MARK	SIZE	SHAPE
1	GI–15M	160, 65, 670
2	GI–15M	260, 650
3	GI–15M	280, 250, 500, 275
4	GI–15M	160, 65, 1170
5	GI–15M	250, 240, 530, 300
6	GI–15M	STRAIGHT
7	GI–15M	STRAIGHT
8	GI–15M	225, 985, 240
9	GI–15M	STRAIGHT
10	GI–15M	160, 65, VARIES
11	GI–15M	STRAIGHT, LENGTH VARIES

NOTES:

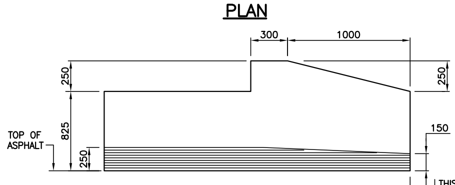
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE I. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S–807.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110–91.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



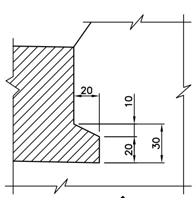
TYPICAL REINFORCING ARRANGEMENT



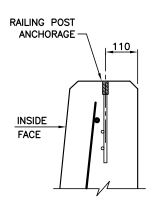
PLAN



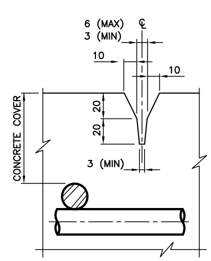
ELEVATION OF BARRIER WALL ON WINGWALL



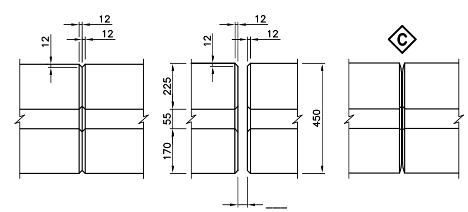
A CHASE DETAIL



B POST ANCHORAGE DETAIL



C CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

C TYPICAL CONTROL JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:

SS110–21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016 | SS110–58

BARRIER WALL WITH RAILING, TL–4 (GFRP REBAR)

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG

METRIC

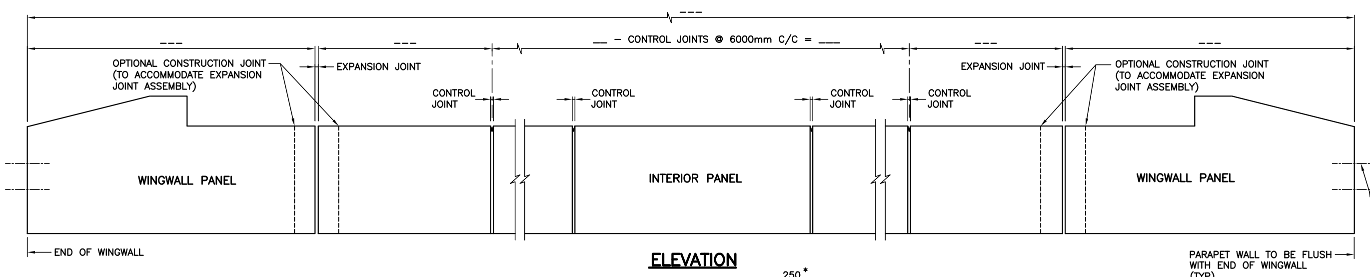
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONT No
WP No

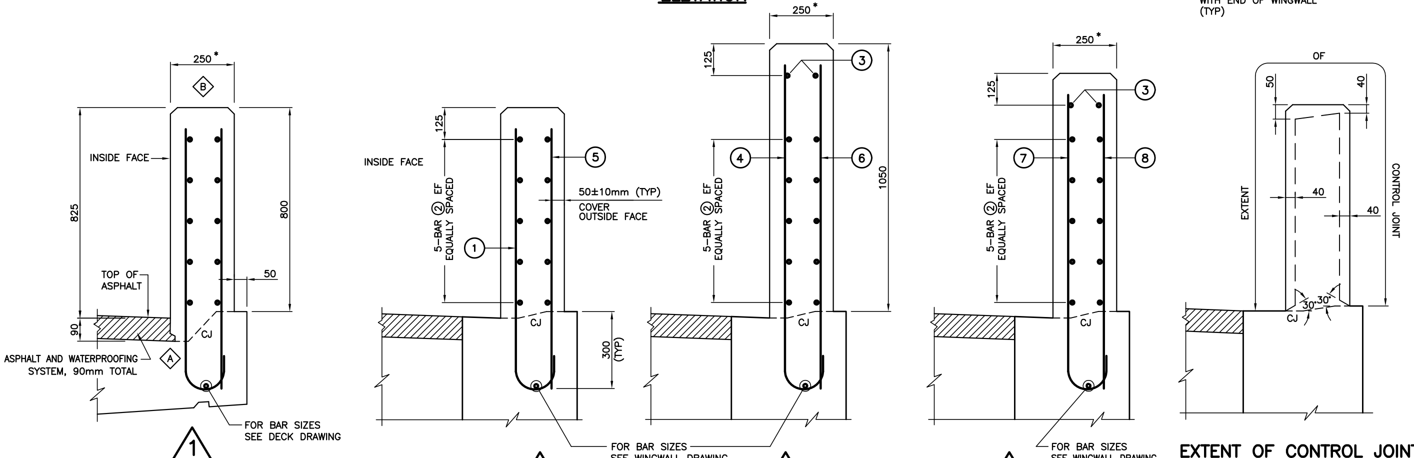
SHEET

PARAPET WALL WITH RAILING, TL-4 (GFRP REBAR)



ELEVATION

*** NOTE TO DESIGNER:**
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.



CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

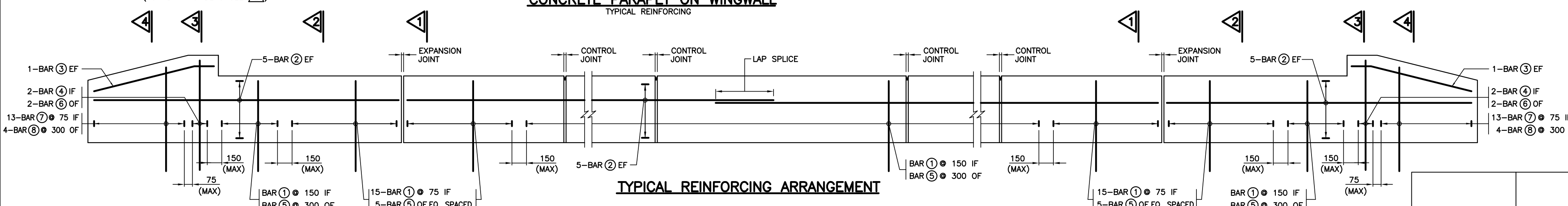
CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCING

EXTENT OF CONTROL JOINT IN PARAPET WALL

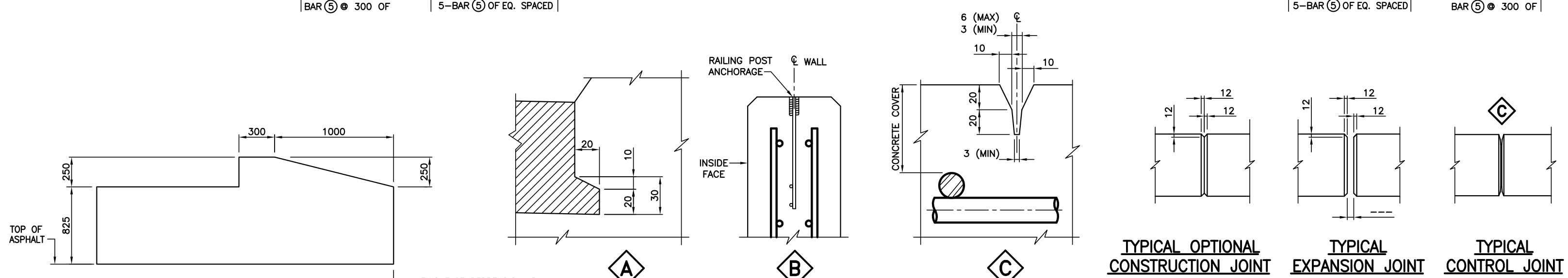
BAR MARK	SIZE	SHAPE
1	GI-20M	190, 80, 950
2	GI-15M	STRAIGHT
3	GI-15M	225, 985, 240
4	GI-20M	190, 80, 1200
5	GI-15M	STRAIGHT
6	GI-15M	STRAIGHT
7	GI-20M	190, 80, VARIES
8	GI-15M	STRAIGHT, LENGTH VARIES

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE I. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110-90.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



TYPICAL REINFORCING ARRANGEMENT



ELEVATION OF PARAPET ON WINGWALL

CHASE DETAIL

POST ANCHORAGE DETAIL

CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:

SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING
SEPTEMBER 2016

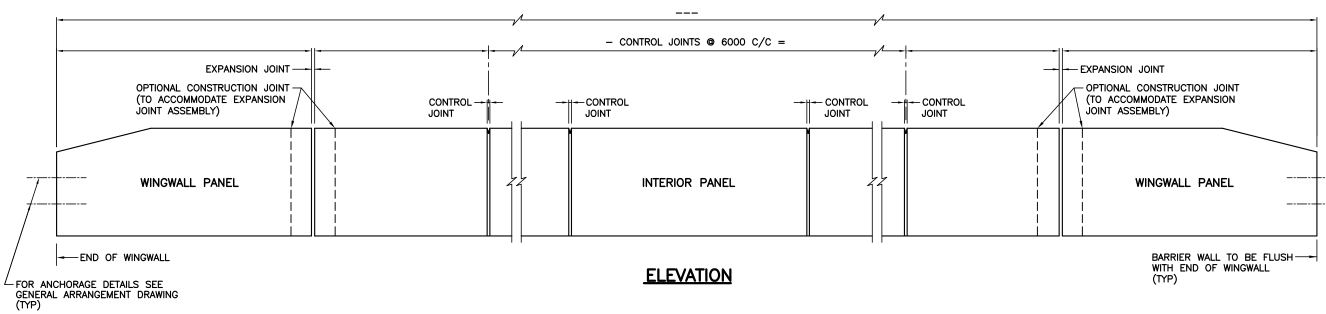
SS110-59

PARAPET WALL WITH RAILING, TL-4 (GFRP REBAR)

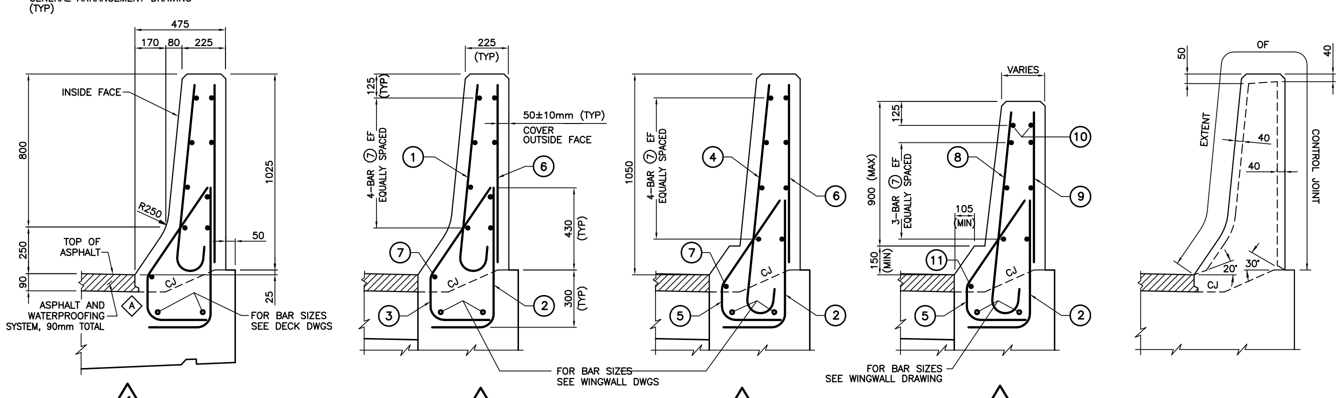
REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



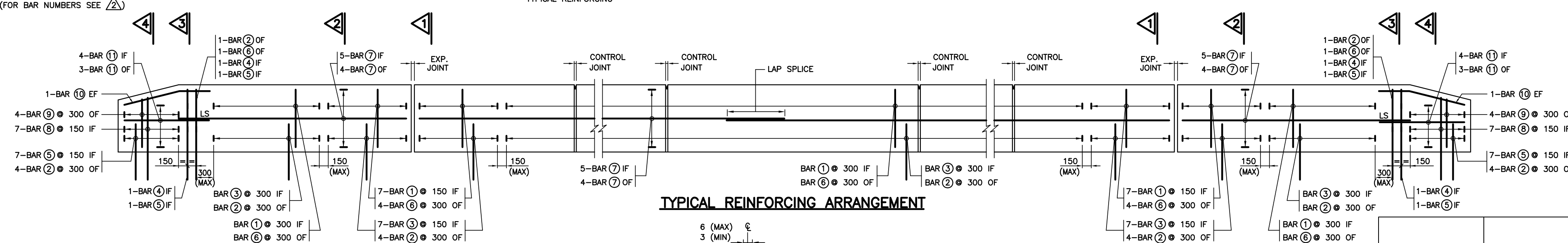
ELEVATION



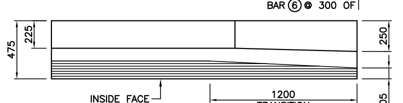
1 BARRIER WALL ON DECK
TYPICAL DIMENSIONS
(FOR BAR NUMBERS SEE 2)

2 3 4 BARRIER WALL ON WINGWALL
TYPICAL REINFORCING

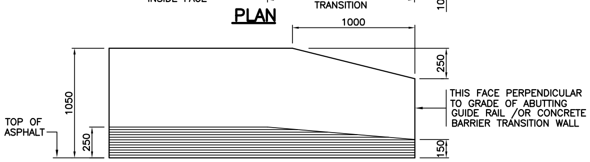
EXTENT OF CONTROL JOINT IN BARRIER WALL



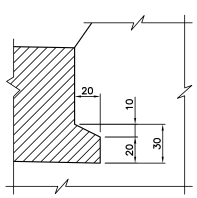
TYPICAL REINFORCING ARRANGEMENT



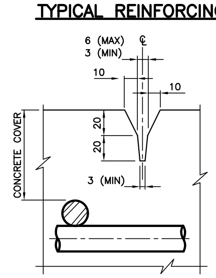
PLAN



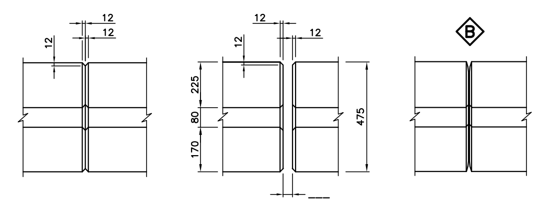
ELEVATION OF BARRIER WALL ON WINGWALL



A CHASE DETAIL



B CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

BARRIER WALL WITHOUT RAILING, TL-5 (STAINLESS STEEL REBAR)

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 900
2	S10M	300, 740
3	S15M	300, 205, 540, 315
4	S15M	130, 65, 1130
5	S15M	300, 160, 540, 315
6	S10M	STRAIGHT
7	S15M	STRAIGHT
8	S15M	130, 65, VARIES
9	S10M	STRAIGHT, LENGTH VARIES
10	S15M	500, 950, 250
11	S15M	STRAIGHT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT
    LS – LAP SPLICE

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS110-61

BARRIER WALL WITHOUT RAILING, TL-5 (STAINLESS STEEL REBAR)

REVISIONS | DESCRIPTION

DESIGN | CHK | CODE CHBDC-14 | DATE
DRAWN | CHK | SITE | DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

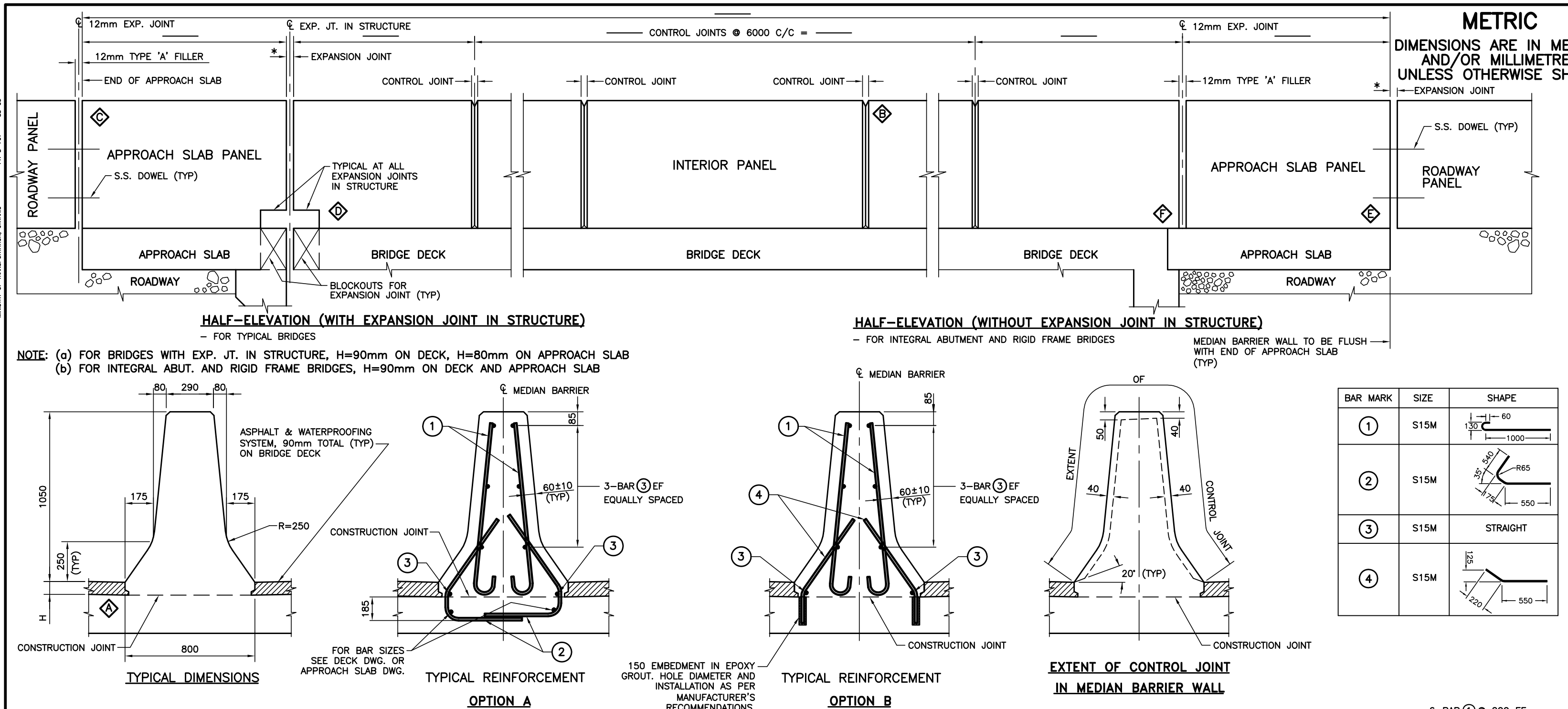
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

REINFORCED CONCRETE MEDIAN BARRIER WALL ON STRUCTURE TYPE I



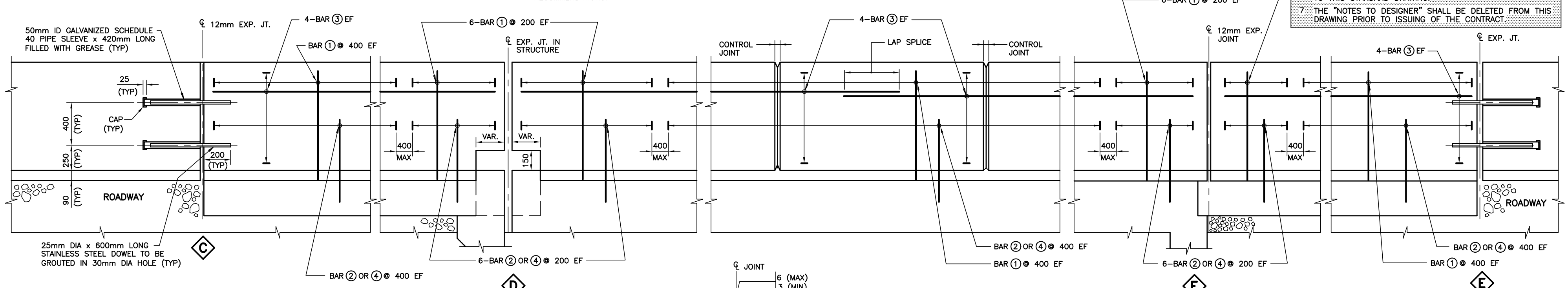
BAR MARK	SIZE	SHAPE
1	S15M	60, 130, 1000
2	S15M	540, 35°, R65, 175, 550
3	S15M	STRAIGHT
4	S15M	125, 220, 550

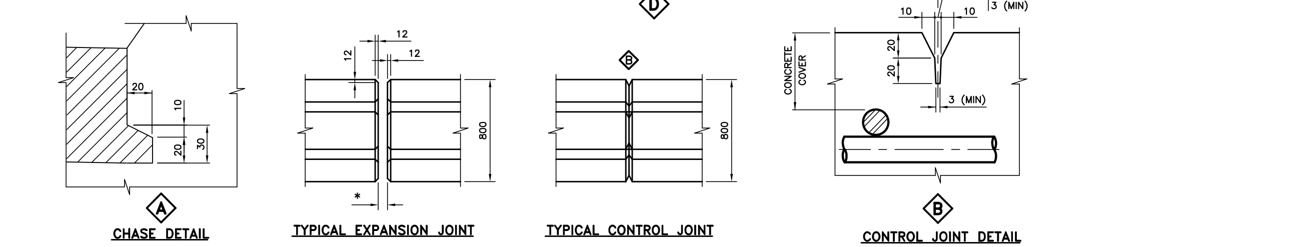
NOTES:

1. SLIPFORMING OF MEDIAN BARRIER WALL IN STRUCTURE IS NOT PERMITTED.
2. MEDIAN BARRIER PANEL LENGTHS SHALL NOT EXCEED 6000mm.
3. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
4. CONTROL JOINTS TO BE FORMED.
5. SAWCUTS NOT PERMITTED.
6. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
7. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
8. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
9. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
10. MINIMUM BAR LAP SPLICE TO BE 700mm.
11. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS.
12. LEGEND:
    EF – DENOTES EACH FACE

NOTES TO DESIGNER

1. DESIGNER SHALL INDICATE WHICH OPTION SHALL BE USED.
2. OPTION 'A' IS RECOMMENDED FOR NEW DECKS AND OPTION 'B' IS FOR EXISTING DECKS.
3. COMBINATIONS OF 'A' AND 'B' OR OPTION 'B' FOR NEW DECKS MAY ALSO BE USED WHERE SUITABLE. EG. POST-TENSIONED DECKS
4. FOR MULTI-SPAN STRUCTURES, A CONTROL JOINT SHOULD BE GIVEN AT EACH CENTRELINE OF PIER. THE TYPICAL 6000 c/c MAX SPACING OF CONTROL JOINTS SHOULD THEN BE ESTABLISHED BETWEEN ALL SUBSTRUCTURE SUPPORTS.
5. * INDICATES EXPANSION JOINT DIMENSION TO BE CALCULATED AND FILLED IN BY DESIGNER.
6. BARS TYPES 2 & 4 SHALL BE SHOWN ON DECK DWG. OR APPROACH SLAB DWG., AND REFERENCE SHALL BE MADE TO THIS STANDARD DRAWING.
7. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.





APPLICABLE STANDARD DRAWINGS

OPSD 3370.100 DECK, WATERPROOFING HOT APPLIED ASHPALT MEMBRANE WITH PROTECTION BOARD

STANDARD DRAWING SEPTEMBER 2016 — SS110-62

REINFORCED CONCRETE MEDIAN BARRIER WALL ON STRUCTURES – TYPE I

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

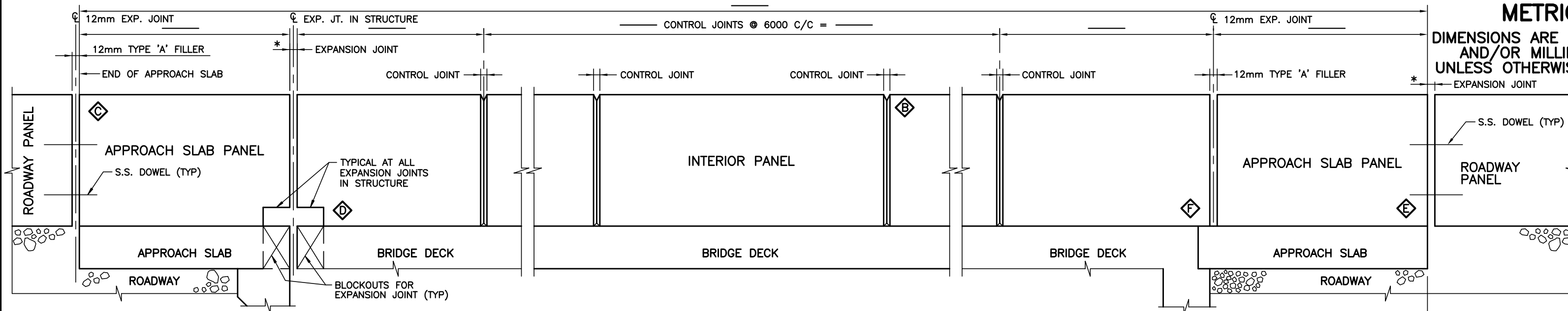
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

REINFORCED CONCRETE MEDIAN BARRIER WALL ON STRUCTURE TYPE II



HALF-ELEVATION (WITH EXPANSION JOINT IN STRUCTURE)

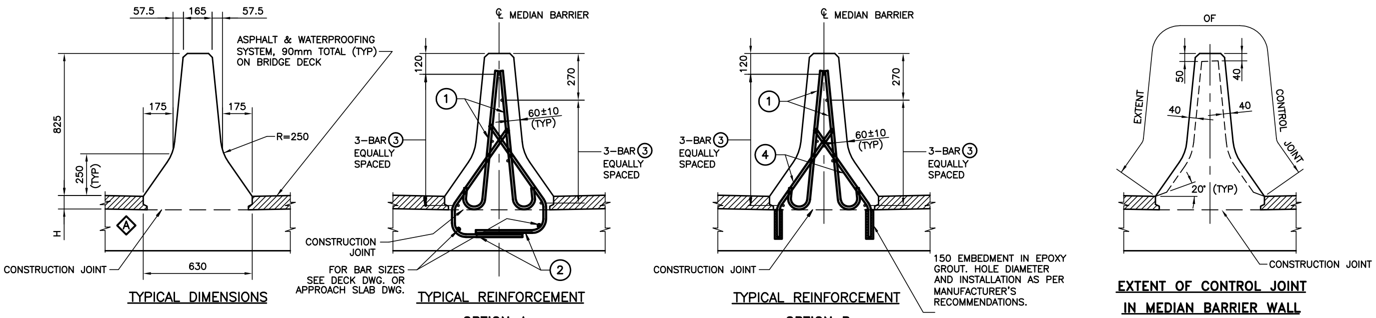
– FOR TYPICAL BRIDGES

HALF-ELEVATION (WITHOUT EXPANSION JOINT IN STRUCTURE)

– FOR INTEGRAL ABUTMENT AND RIGID FRAME BRIDGES

MEDIAN BARRIER WALL TO BE FLUSH WITH END OF APPROACH SLAB (TYP)

NOTE: (a) FOR BRIDGES WITH EXP. JT. IN STRUCTURE, H=90mm ON DECK, H=80mm ON APPROACH SLAB
(b) FOR INTEGRAL ABUT. AND RIGID FRAME BRIDGES, H=90mm ON DECK AND APPROACH SLAB



TYPICAL DIMENSIONS

TYPICAL REINFORCEMENT

OPTION A

TYPICAL REINFORCEMENT

OPTION B

EXTENT OF CONTROL JOINT IN MEDIAN BARRIER WALL

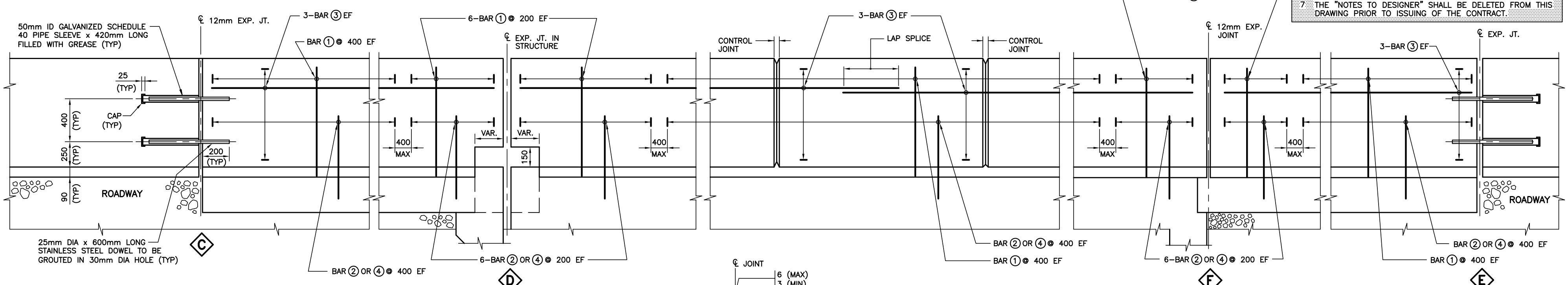
BAR MARK	SIZE	SHAPE
①	S15M	60, 130, 745
②	S15M	R65, 405, 35°, 175, 550
③	S15M	STRAIGHT
④	S15M	125, 220, 550

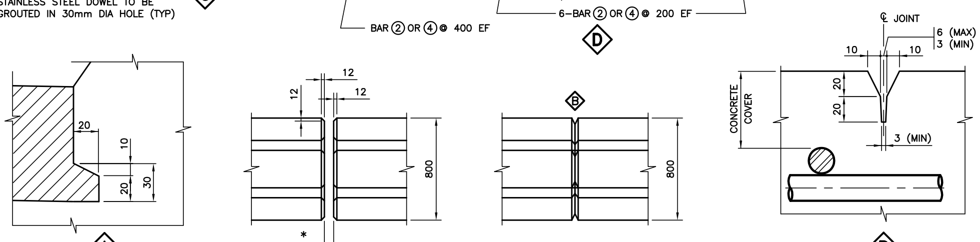
NOTES:

1. SLIPFORMING OF MEDIAN BARRIER WALL IN STRUCTURE IS NOT PERMITTED.
2. MEDIAN BARRIER PANEL LENGTHS SHALL NOT EXCEED 6000mm.
3. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
4. CONTROL JOINTS TO BE FORMED.
5. SAWCUTS NOT PERMITTED.
6. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
7. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
8. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
9. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
10. MINIMUM BAR LAP SPLICE TO BE 700mm.
11. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS.
12. LEGEND:
    EF – DENOTES EACH FACE

NOTES TO DESIGNER

1. DESIGNER SHALL INDICATE WHICH OPTION SHALL BE USED.
2. OPTION 'A' IS RECOMMENDED FOR NEW DECKS AND OPTION 'B' IS FOR EXISTING DECKS.
3. COMBINATIONS OF 'A' AND 'B' OR OPTION 'B' FOR NEW DECKS MAY ALSO BE USED WHERE SUITABLE. EG. POST-TENSIONED DECKS
4. FOR MULTI-SPAN STRUCTURES, A CONTROL JOINT SHOULD BE GIVEN AT EACH CENTRELINE OF PIER. THE TYPICAL 6000 c/c MAX SPACING OF CONTROL JOINTS SHOULD THEN BE ESTABLISHED BETWEEN ALL SUBSTRUCTURE SUPPORTS.
5. * INDICATES EXPANSION JOINT DIMENSION TO BE CALCULATED AND FILLED IN BY DESIGNER.
6. BARS TYPES ② & ④ SHALL BE SHOWN ON DECK DWG. OR APPROACH SLAB DWG., AND REFERENCE SHALL BE MADE TO THIS STANDARD DRAWING.
7. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.





CHASE DETAIL

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

CONTROL JOINT DETAIL

APPLICABLE STANDARD DRAWINGS

OPSD 3370.100 DECK, WATERPROOFING HOT APPLIED ASHPALT MEMBRANE WITH PROTECTION BOARD

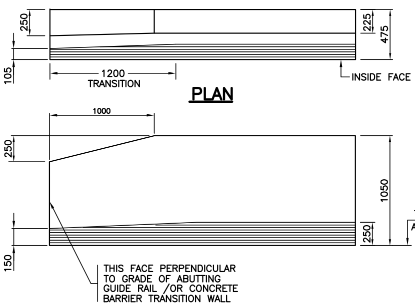
STANDARD DRAWING SEPTEMBER 2016 | SS110-63

REINFORCED CONCRETE MEDIAN BARRIER WALL ON STRUCTURES – TYPE II

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

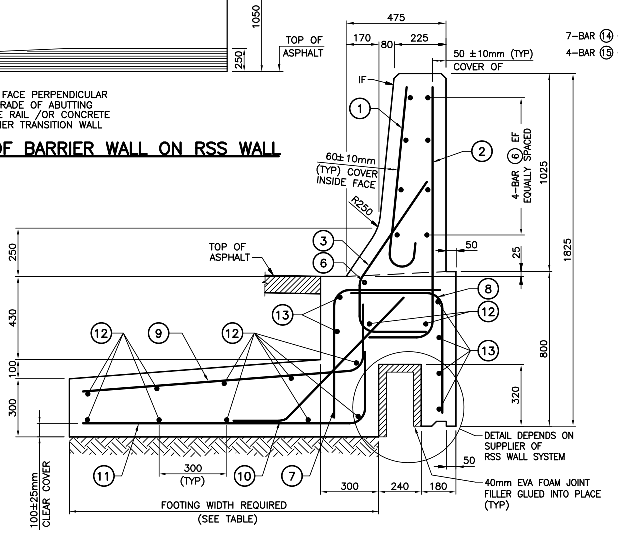
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE	
DRAWN	CHK	SITE		DWG	



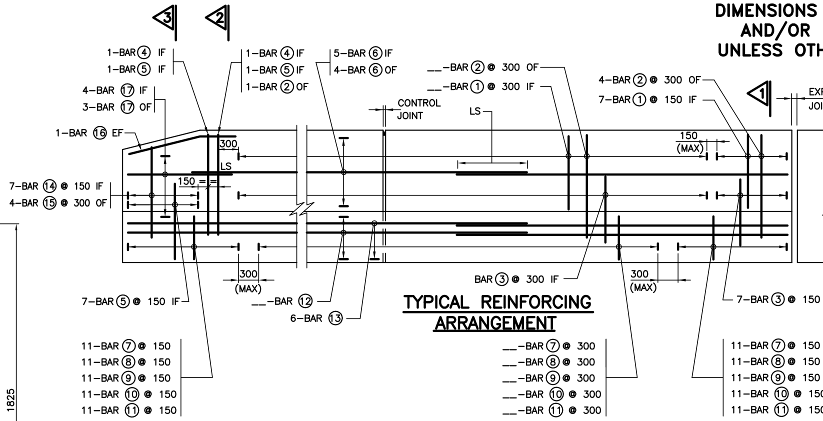
PLAN

ELEVATION OF BARRIER WALL ON RSS WALL

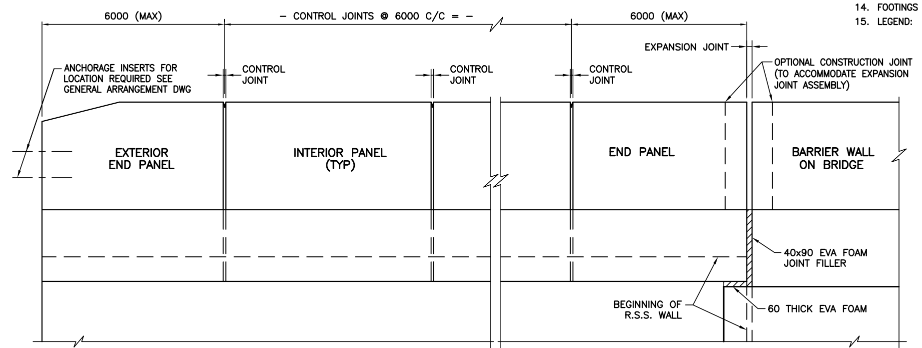


BARRIER WALL ON R.S.S. WALL

TYPICAL DIMENSIONS



TYPICAL REINFORCING ARRANGEMENT



ELEVATION

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

WP No

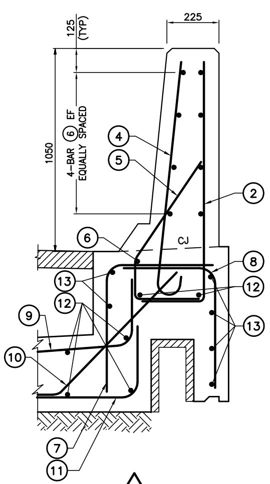
BARRIER WALL WITHOUT RAILING ON RSS WALL, TL-5 (STAINLESS STEEL REBAR)

SHEET

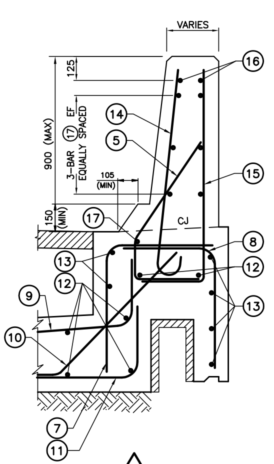
NOTES:

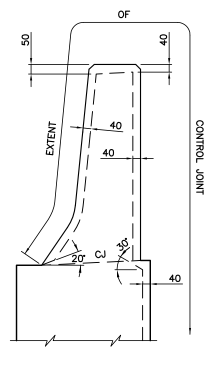
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RETAINED SOIL SYSTEM WALL, BARRIER WALL AND FOOTING, SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.70.56.
3. CONCRETE COVER TO REINFORCING STEEL 70±20mm, EXCEPT AS NOTED.
4. CLASS OF CONCRETE FOR FOOTING 30MPa.
5. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa AND GRADE 400W REINFORCING STEEL. SEE REINFORCING TABLE BELOW.
6. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
7. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
8. MINIMUM BAR LAP SPLICE TO BE 700mm, UNLESS OTHERWISE SHOWN.
9. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
10. CONTROL JOINT TO BE FORMED.
11. SAWCUTS NOT PERMITTED.
12. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
13. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL
14. FOOTINGS SHALL HAVE CONSTRUCTION JOINTS AT MAX SPACING OF 12.0M.
15. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT
    LS – LAP SPLICE

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 900
2	S10M	260, 1250
3	S15M	260, 265, 600, 350
4	S15M	130, 65, 1190
5	S15M	260, 230, 600, 350
6	S15M	STRAIGHT
7	S15M	650, 570
8	S15M	570, 650
9	S15M	350, VARIES
10	S15M	150, 945, 645
11	15M	350, VARIES
12	15M	STRAIGHT
13	S15M	STRAIGHT
14	S15M	130, 65, VARIES
15	S10M	260, VARIES
16	S15M	500, 950, 250
17	S15M	STRAIGHT

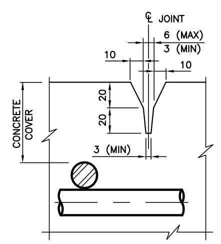


BARRIER WALL AT EXTERIOR END PANEL

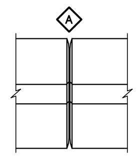




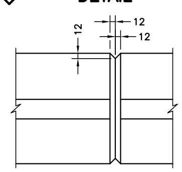
EXTENT OF CONTROL JOINT IN BARRIER WALL



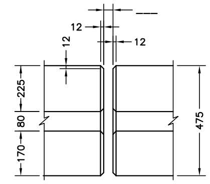
CONTROL JOINT DETAIL



TYPICAL CONTROL JOINT



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT

NOTES TO DESIGNER

1 THE DESIGNER SHALL SHOW DETAIL OF STUB WALL, AS IS COMMONLY REQUIRED, AT THE BEGINNING OF THE RSS WALL.

2 THE FOOTING WIDTH REQUIRED IS BASED ON THE FOOTING LENGTH FOR THIS PROJECT AS PER TABLE FOUND BELOW, AND SHALL BE FILLED IN ON THIS DRAWING BY THE DESIGNER.

	FOOTING LENGTH		
	≤6.0m	6.0m TO 15.0m	>15.0m
	*	**	**
FOOTING WIDTH REQUIRED	2500mm	2250mm	1750mm

* – WITH APPROACH SLAB

** – WITHOUT APPROACH SLAB

3 THIS DRAWING IS NOT SUITABLE FOR ANTICIPATED SETTLEMENT OF UNDERLYING SOIL LARGER THAN 25mm FOR SUCH CASES, FOLLOW MTO RSS DESIGN GUIDELINES.

4 THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

STANDARD DRAWING SEPTEMBER 2016

SS110-64

BARRIER WALL WITHOUT RAILING ON RSS WALL, TL-5 (STAINLESS STEEL REBAR)

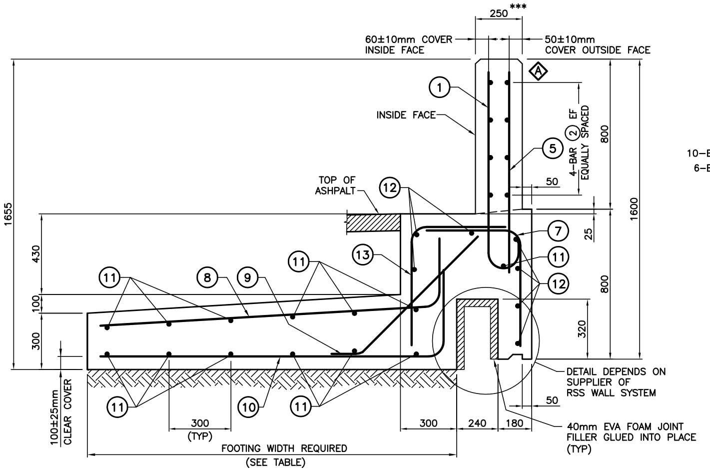
REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD		DATE
DRAWN	CHK	SITE			DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

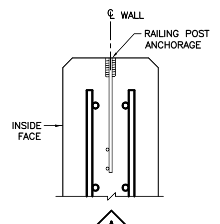
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

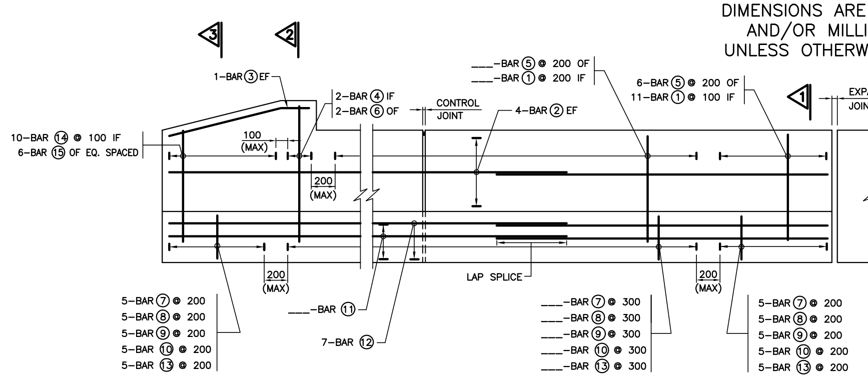
PARAPET WALL WITH RAILING ON RSS WALL, TL-4 (STAINLESS STEEL REBAR)



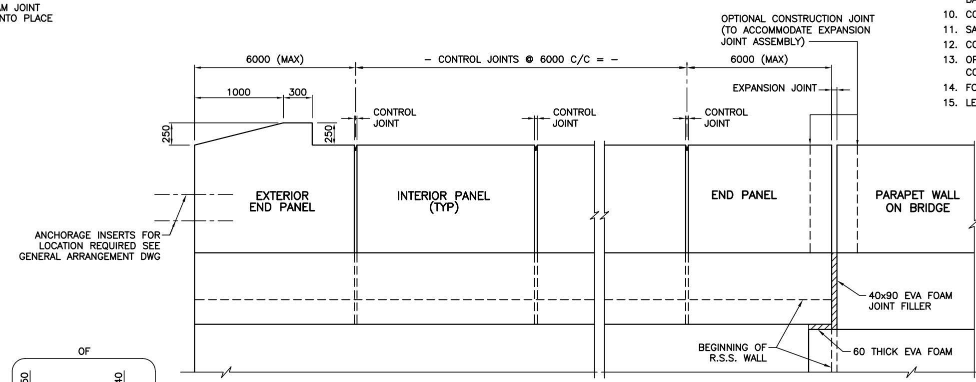
1 PARAPET WALL ON R.S.S. WALL
TYPICAL DIMENSIONS



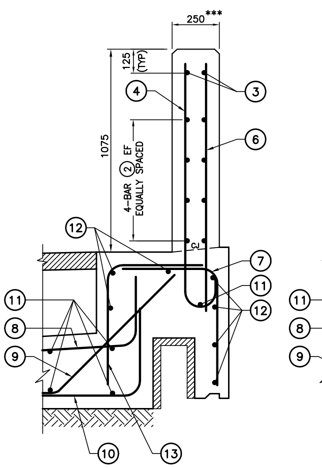
A POST ANCHORAGE DETAIL

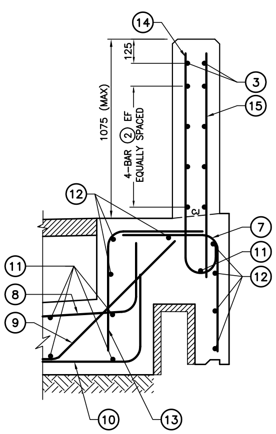


TYPICAL REINFORCING ARRANGEMENT

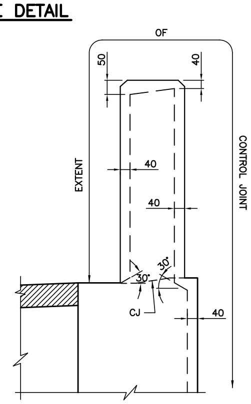


ELEVATION

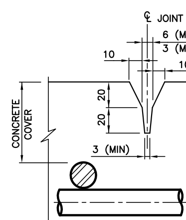




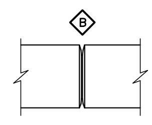
2 3 PARAPET WALL AT EXTERIOR END PANEL



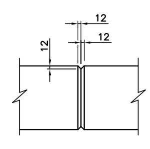
EXTENT OF CONTROL JOINT IN PARAPET WALL



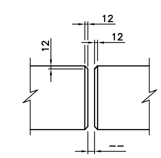
B CONTROL JOINT DETAIL



TYPICAL CONTROL JOINT



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RETAINED SOIL SYSTEM WALL, PARAPET WALL AND FOOTING, SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.70.56.
3. CONCRETE COVER TO REINFORCING STEEL 70±20mm, EXCEPT AS NOTED.
4. CLASS OF CONCRETE FOR FOOTING 30 MPa.
5. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa AND GRADE 400W REINFORCING STEEL. SEE REINFORCING TABLE BELOW.
6. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
7. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
8. MINIMUM BAR LAP SPLICE TO BE 700mm, UNLESS OTHERWISE SHOWN.
9. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
10. CONTROL JOINT TO BE FORMED.
11. SAWCUTS NOT PERMITTED.
12. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
13. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
14. FOOTINGS SHALL HAVE CONSTRUCTION JOINTS AT MAX SPACING OF 12.0M.
15. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – DENOTES CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	S15M	65, 160, 965
2	S15M	STRAIGHT
3	S15M	950, 250
4	S15M	65, 160, 1215
5	S10M	STRAIGHT
6	S10M	STRAIGHT
7	S15M	570, 650
8	S15M	350, VARIES
9	S15M	150, 945, 645
10	15M	350, VARIES
11	15M	STRAIGHT
12	S15M	STRAIGHT
13	S15M	570, 650
14	S15M	65, 160, VARIES
15	S10M	STRAIGHT, LENGTH VARIES

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

NOTES TO DESIGNER

1. THE DESIGNER SHALL SHOW DETAIL OF STUB WALL, AS IS COMMONLY REQUIRED, AT THE BEGINNING OF THE RSS WALL.
2. THE FOOTING WIDTH REQUIRED IS BASED ON THE FOOTING LENGTH FOR THIS PROJECT AS PER TABLE FOUND BELOW, AND SHALL BE FILLED IN ON THIS DRAWING BY THE DESIGNER.

	FOOTING LENGTH		
	≤6.0m	6.0m TO 15.0m	>15.0m
	*	**	**
FOOTING WIDTH REQUIRED	2500mm	2250mm	1750mm

* – WITH APPROACH SLAB
** – WITHOUT APPROACH SLAB

3. *** INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.
4. THIS DRAWING IS NOT SUITABLE FOR ANTICIPATED SETTLEMENT OF UNDERLYING SOIL LARGER THAN 25mm FOR SUCH CASES, FOLLOW MTO RSS DESIGN GUIDELINES.
5. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

APPLICABLE STANDARD DRAWINGS
SS110-21 RAILING FOR BARRIER/PARAPET WALL

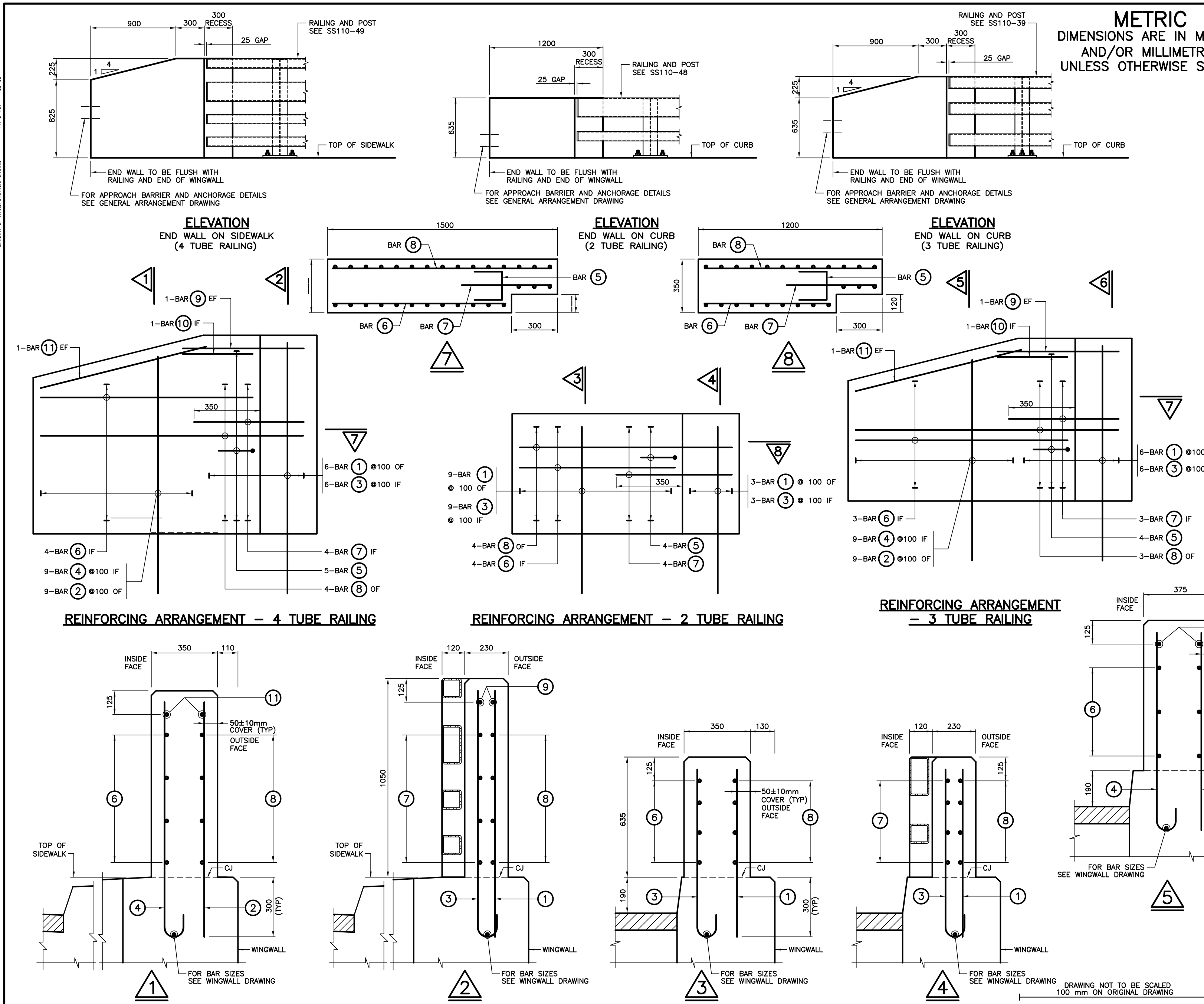
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING SEPTEMBER 2016 | SS110-65
PARAPET WALL WITH RAILING ON RSS WALL, TL-4 (STAINLESS STEEL REBAR)

REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



CONT No	
WP No	
CONCRETE END WALL FOR BOX BEAM RAILING (STAINLESS STEEL REBAR)	SHEET

NOTES:

1. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
2. REINFORCING STEEL SHALL BE STATINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPa.
3. LEGEND: EF – DENOTES EACH FACE
   IF – DENOTES INSIDE FACE
   OF – DENOTES OUTSIDE FACE
   CJ – DENOTES CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	S10M	STRAIGHT
2	S10M	STRAIGHT VARIES
3	S15M	130, 65
4	S15M	130, 65, VARIES
5	S15M	180
6	S15M	STRAIGHT
7	S15M	STRAIGHT
8	S15M	STRAIGHT
9	S15M	STRAIGHT
10	S15M	STRAIGHT
11	S15M	STRAIGHT

STANDARD DRAWING MARCH 2016	SS110-66
CONCRETE END WALL FOR BOX BEAM RAILING (STAINLESS STEEL REBAR)	

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

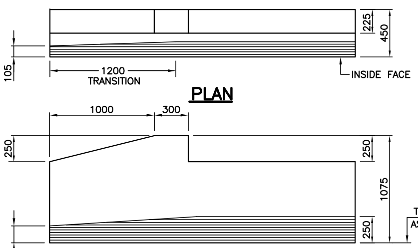
MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

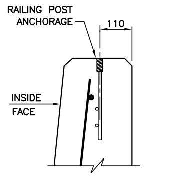
CONT No
WP No

SHEET

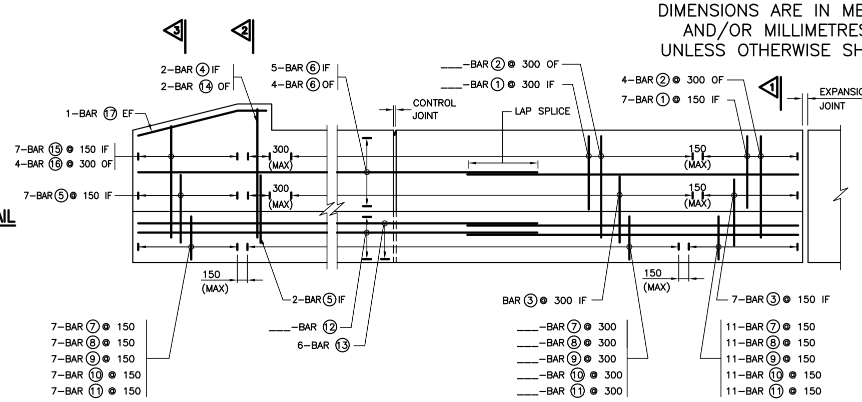
BARRIER WALL WITH RAILING ON RSS WALL, TL-4 (STAINLESS STEEL REBAR)



ELEVATION OF BARRIER WALL ON RSS WALL



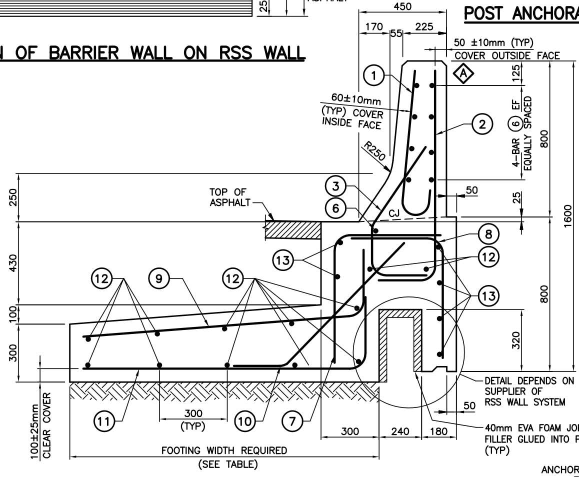
A POST ANCHORAGE DETAIL



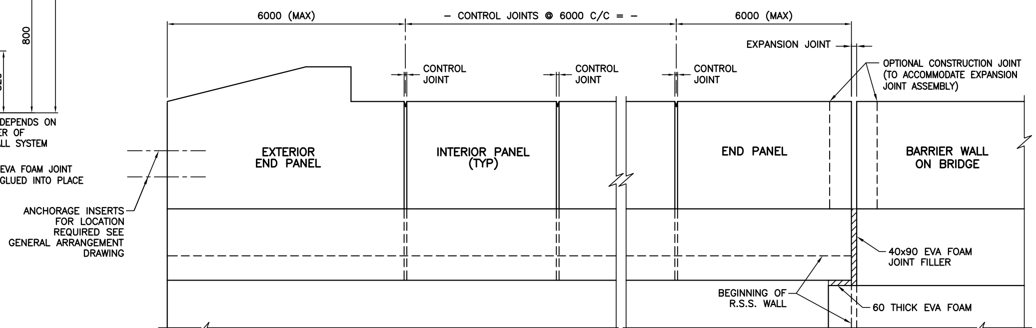
TYPICAL REINFORCING ARRANGEMENT

NOTES:

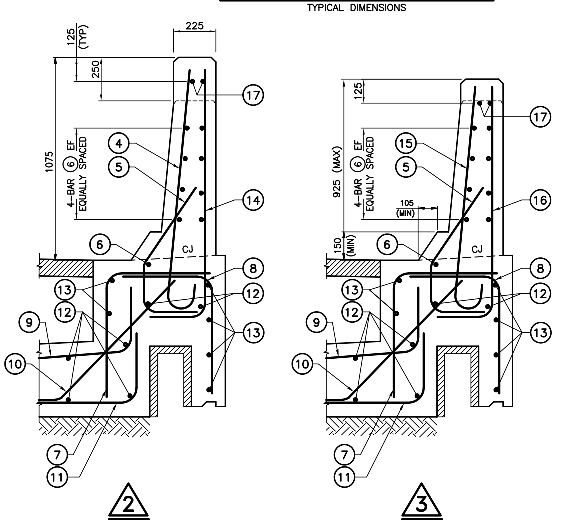
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RETAINED SOIL SYSTEM WALL, BARRIER WALL AND FOOTING, SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.70.56.
3. CONCRETE COVER TO REINFORCING STEEL 70±20mm, EXCEPT AS NOTED.
4. CLASS OF CONCRETE FOR FOOTING 30 MPa.
5. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa AND GRADE 400W. SEE REINFORCING TABLE BELOW.
6. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
7. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
8. MINIMUM BAR LAP SPLICE TO BE 700mm, UNLESS OTHERWISE SHOWN.
9. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
10. CONTROL JOINT TO BE FORMED.
11. SAWCUTS NOT PERMITTED.
12. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
13. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL
14. FOOTINGS SHALL HAVE CONSTRUCTION JOINTS AT MAX SPACING OF 12.0M.
15. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



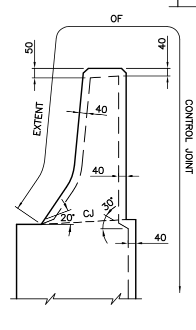
1 BARRIER WALL ON R.S.S. WALL
TYPICAL DIMENSIONS



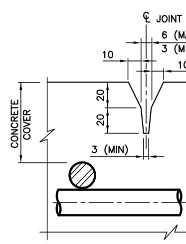
ELEVATION



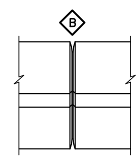
2 3 BARRIER WALL AT EXTERIOR END PANEL



EXTENT OF CONTROL JOINT IN BARRIER WALL



B CONTROL JOINT DETAIL



TYPICAL CONTROL JOINT

NOTES TO DESIGNER

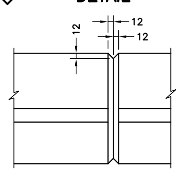
1. THE DESIGNER SHALL SHOW DETAIL OF STUB WALL, AS IS COMMONLY REQUIRED, AT THE BEGINNING OF THE RSS WALL.
2. THE FOOTING WIDTH REQUIRED IS BASED ON THE FOOTING LENGTH FOR THIS PROJECT AS PER TABLE FOUND BELOW, AND SHALL BE FILLED IN ON THIS DRAWING BY THE DESIGNER.

	FOOTING LENGTH		
	≤6.0m	6.0m TO 15.0m	>15.0m
	*	**	**
FOOTING WIDTH REQUIRED	2500mm	2250mm	1750mm

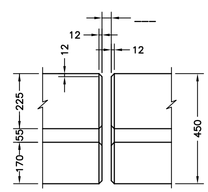
* – WITH APPROACH SLAB
** – WITHOUT APPROACH SLAB

3. THIS DRAWING IS NOT SUITABLE FOR ANTICIPATED SETTLEMENT OF UNDERLYING SOIL LARGER THAN 25mm FOR SUCH CASES, FOLLOW MTO RSS DESIGN GUIDELINES.
4. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 670
2	S10M	260, 1025
3	S15M	260, 170, 600, 350
4	S15M	130, 65, 1170
5	S15M	260, 150, 600, 350
6	S15M	STRAIGHT
7	S15M	650, 570
8	S15M	570, 650
9	S15M	3, 350, VARIES
10	S15M	150, 945, 645
11	15M	350, VARIES
12	15M	STRAIGHT
13	S15M	STRAIGHT
14	S10M	260, 1275
15	S15M	130, 65, VARIES
16	S10M	260, VARIES
17	S15M	950, 250



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT

APPLICABLE STANDARD DRAWINGS:
SS110–21 RAILING FOR BARRIER/PARAPET WALL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

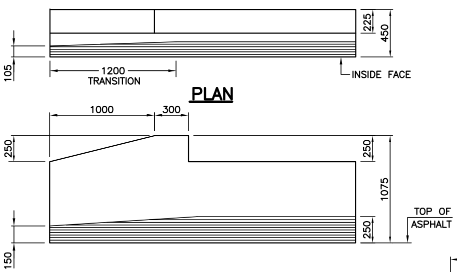
STANDARD DRAWING
SEPTEMBER 2016

SS110–68

BARRIER WALL WITH RAILING ON RSS WALL, TL-4 (STAINLESS STEEL REBAR)

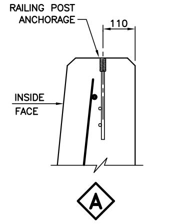
REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05



PLAN

ELEVATION OF BARRIER WALL ON RSS WALL



POST ANCHORAGE DETAIL

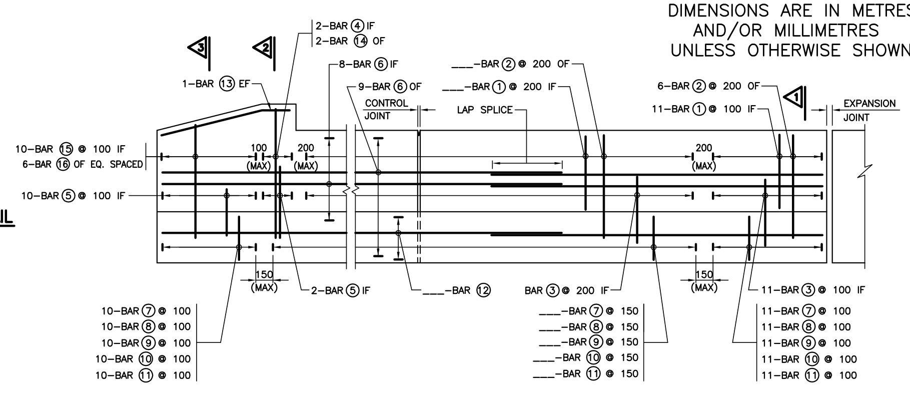
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

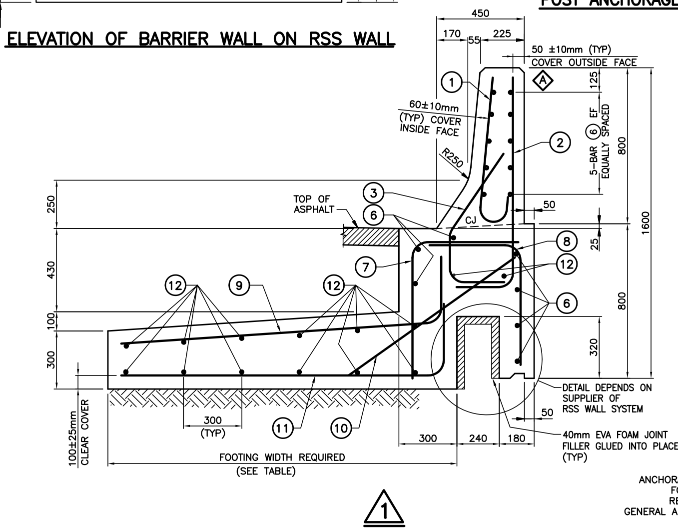
BARRIER WALL WITH RAILING ON RSS WALL, TL-4 (GFRP REBAR)



TYPICAL REINFORCING ARRANGEMENT

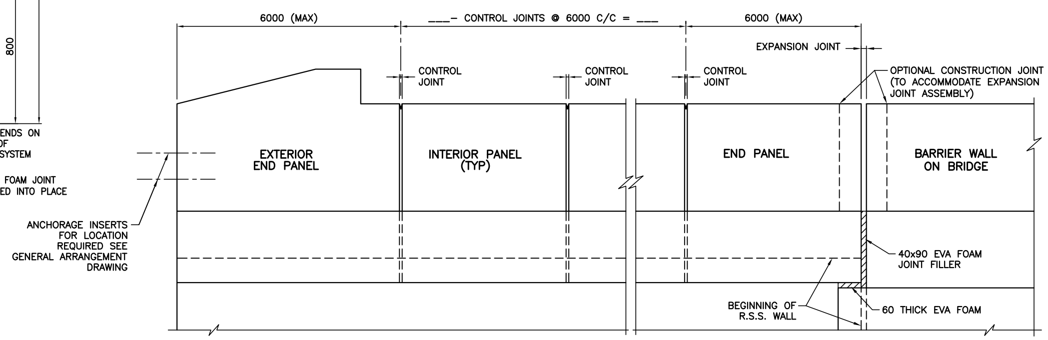
NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RETAINED SOIL SYSTEM WALL, BARRIER WALL AND FOOTING, SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.70.56.
3. CONCRETE COVER TO REINFORCING BAR 70±20mm, EXCEPT AS NOTED.
4. CLASS OF CONCRETE FOR FOOTING 30 MPa.
5. GLASS FIBRE REINFORCED POLYMER(GRFP) SHALL BE GRADE I, SIZE IN THE BAR SCHEDULE INDICATES GRADE AND DESIGNATED BAR DIAMETERS AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
6. REINFORCING STEEL SHALL BE GRADE 400W
7. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
8. MINIMUM BAR LAP SPLICE TO BE 700mm, UNLESS OTHERWISE SHOWN.
9. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
10. CONTROL JOINT TO BE FORMED.
11. SAWCUTS NOT PERMITTED.
12. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
13. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL
14. FOOTINGS SHALL HAVE CONSTRUCTION JOINTS AT MAX SPACING OF 12.0M.
15. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



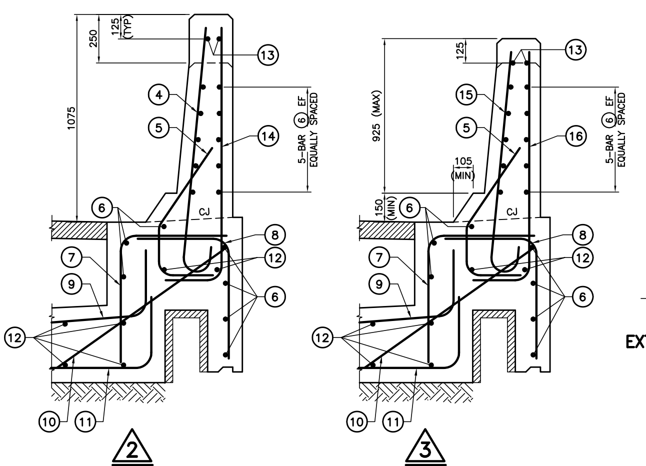
BARRIER WALL ON R.S.S. WALL

TYPICAL DIMENSIONS

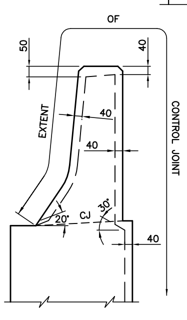


ELEVATION

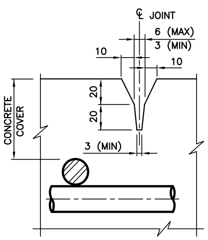
BAR MARK	SIZE	SHAPE
1	GI–15M	160, 65
2	GI–15M	280, 1025
3	GI–15M	280, 250, 500, 350
4	GI–15M	160, 65
5	GI–15M	250, 240, 530, 300
6	GI–15M	STRAIGHT
7	GI–15M	650, 570
8	GI–15M	570, 650
9	GI–15M	3°, VARIES, 350
10	GI–15M	STRAIGHT
11	15M	VARIES, 350
12	15M	STRAIGHT
13	GI–15M	950, 250
14	GI–15M	280, 1275
15	GI–15M	160, 65, VARIES
16	GI–15M	280, VARIES



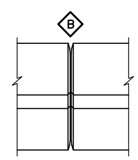
BARRIER WALL AT EXTERIOR END PANEL



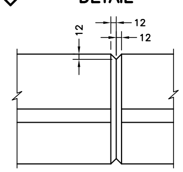
EXTENT OF CONTROL JOINT IN BARRIER WALL



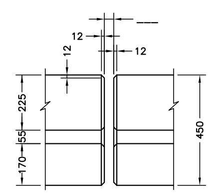
CONTROL JOINT DETAIL



TYPICAL CONTROL JOINT



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT

NOTES TO DESIGNER

1 THE DESIGNER SHALL SHOW DETAIL OF STUB WALL, AS IS COMMONLY REQUIRED, AT THE BEGINNING OF THE RSS WALL.

2 THE FOOTING WIDTH REQUIRED IS BASED ON THE FOOTING LENGTH FOR THIS PROJECT AS PER TABLE FOUND BELOW, AND SHALL BE FILLED IN ON THIS DRAWING BY THE DESIGNER.

	FOOTING LENGTH		
	≤6.0m	6.0m TO 15.0m	>15.0m
	*	**	**
FOOTING WIDTH REQUIRED	2500mm	2250mm	1750mm

* – WITH APPROACH SLAB
** – WITHOUT APPROACH SLAB

3 THIS DRAWING IS NOT SUITABLE FOR ANTICIPATED SETTLEMENT OF UNDERLYING SOIL LARGER THAN 25mm. FOR SUCH CASES, FOLLOW MTO RSS DESIGN GUIDELINES.

4 THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

APPLICABLE STANDARD DRAWINGS:

SS110-21 RAILING FOR BARRIER/PARAPET WALL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING
SEPTEMBER 2016

SS110-69

BARRIER WALL WITH RAILING ON RSS WALL, TL-4 (GFRP REBAR)

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO   PR-D-707   88-05

METRIC

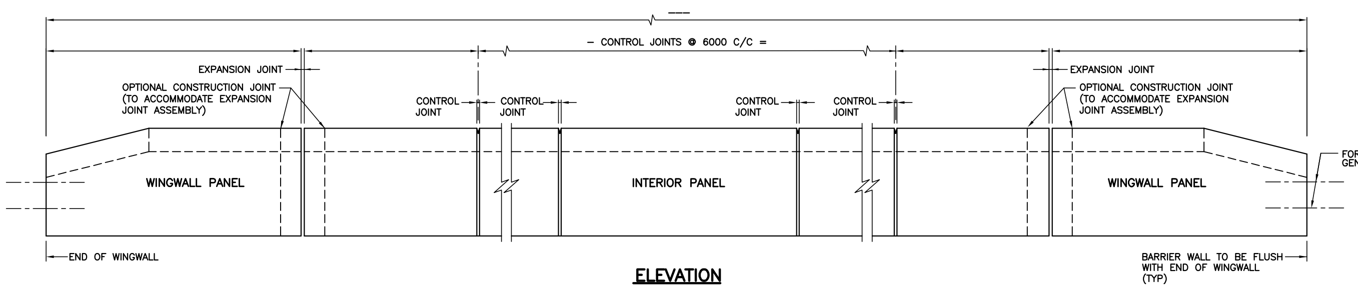
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

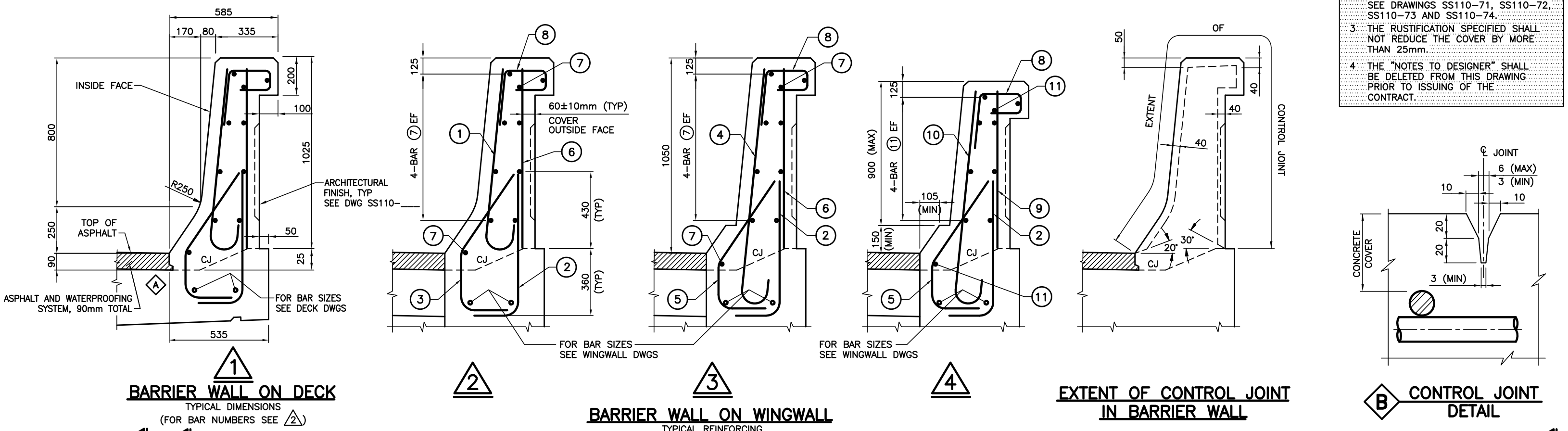
DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

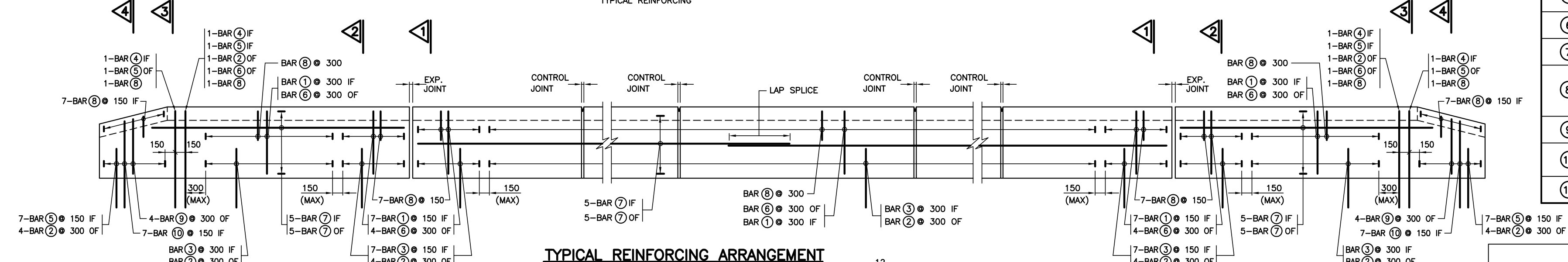
CONT No
WP No

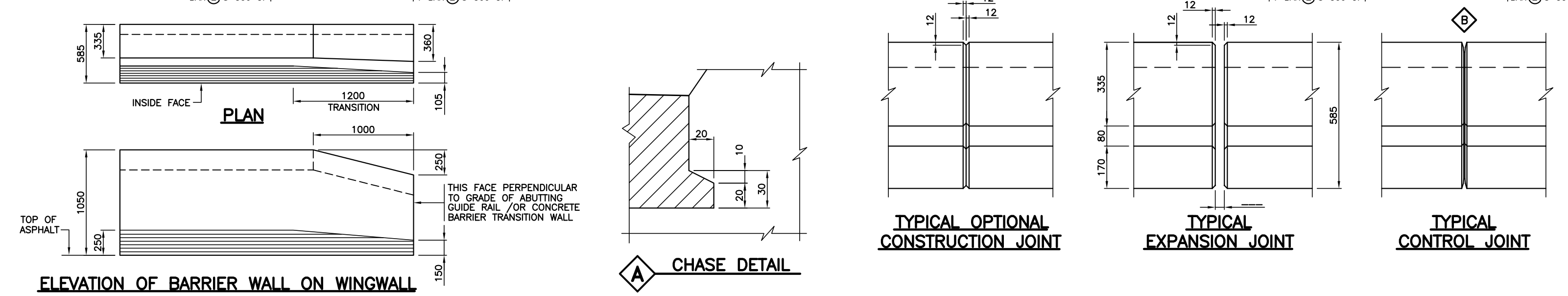
SHEET

BARRIER WALL WITH ARCHITECTURE FINISH, TL-5 (STAINLESS STEEL REBAR)









NOTES TO DESIGNER

1. THE ARCHITECTURAL FINISH OF THE SURFACE SHOWN SHALL BE AS SPECIFIED BY THE REGION.
2. FOR STANDARD ARCHITECTURAL FINISHES SEE DRAWINGS SS110-71, SS110-72, SS110-73 AND SS110-74.
3. THE RUSTIFICATION SPECIFIED SHALL NOT REDUCE THE COVER BY MORE THAN 25mm.
4. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. LEGEND: EF – DENOTES EACH FACE
IF – DENOTES INSIDE FACE
OF – DENOTES OUTSIDE FACE
CJ – DENOTES CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 900
2	S10M	250, 800
3	S15M	250, 265, 540, 315
4	S15M	130, 65, 1190
5	S15M	250, 220, 540, 315
6	S10M	STRAIGHT
7	S15M	STRAIGHT
8	S10M	120, 210, 100, 30, 300
9	S10M	STRAIGHT LENGTH VARIES
10	S15M	130, 65, VARIES
11	S15M	STRAIGHT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016 | SS110-70

BARRIER WALL WITH ARCHITECTURAL FINISH, TL-5 (STAINLESS STEEL REBAR)

REVISIONS | DESCRIPTION

DESIGN | CHK | CODE CHBDC-14 | DATE
DRAWN | CHK | SITE | DWG

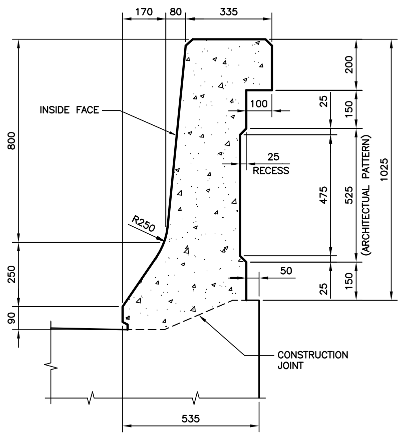
METRIC

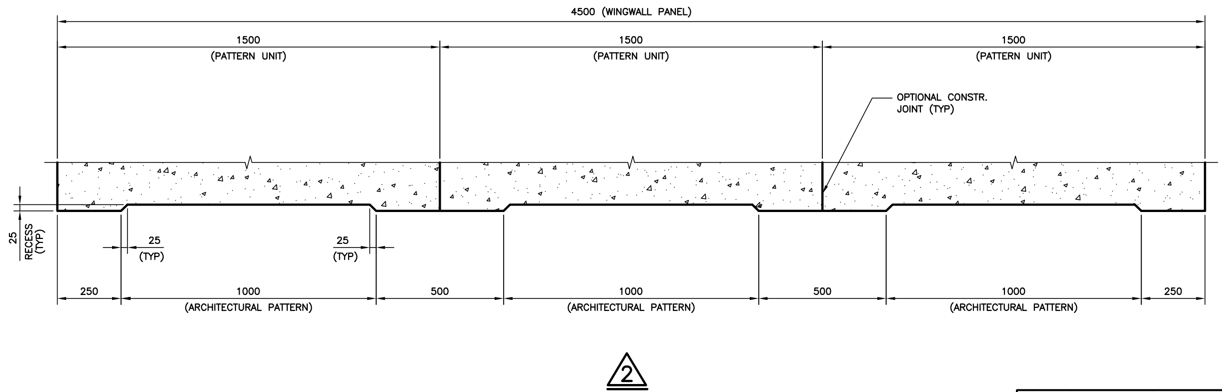
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

ARCHITECTURAL FINISH (TYPE A) FOR TL-5 BARRIER WALL

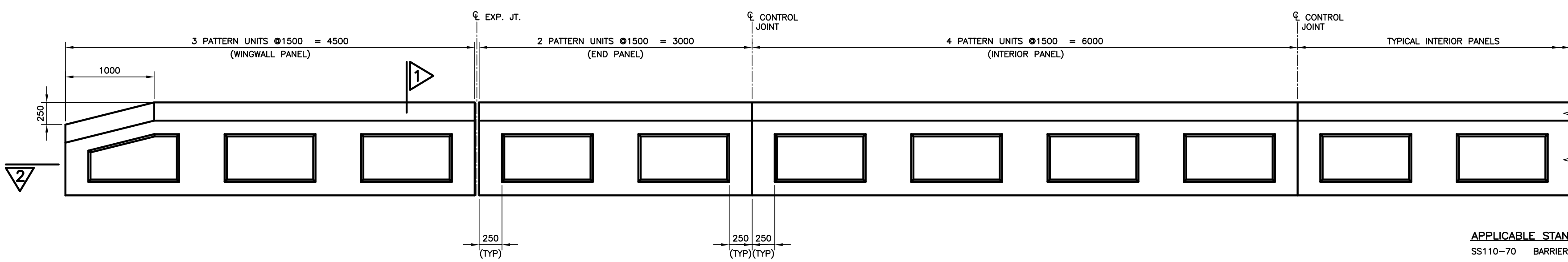




WINGWALL PANEL AS SHOWN; END AND INTERIOR PANELS SIMILAR

NOTES TO DESIGNER:

1. ARCHITECTURAL PATTERN UNIT LENGTH = 1500mm
2. WINGWALL AND END PANEL LENGTHS MUST BE MULTIPLES OF 0.5m; SUCH AS 0.5m, 1.0m, 1.5m, 2.0m . . . ETC.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



ELEVATION – BARRIER WALLS WITH ARCHITECTUAL TYPE-A FINISH

APPLICABLE STANDARD DRAWINGS

SS110-70 BARRIER WALL WITH ARCHITECTURAL FINISH, TL-5

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016	SS110-71
ARCHITECTURAL FINISH (TYPE A) FOR TL-5 BARRIER WALL	

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS

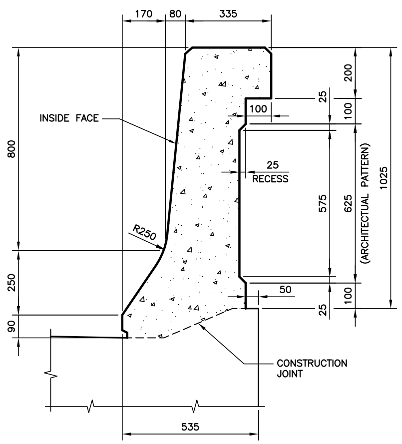
			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

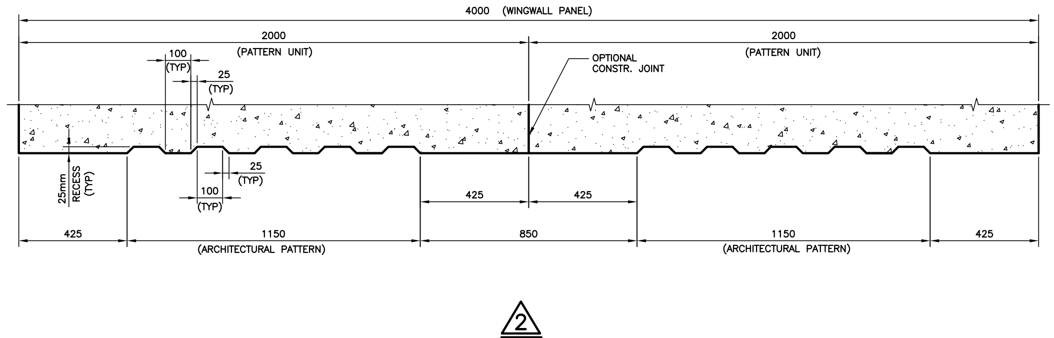
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

ARCHITECTURAL FINISH (TYPE B)
FOR TL-5 BARRIER WALL

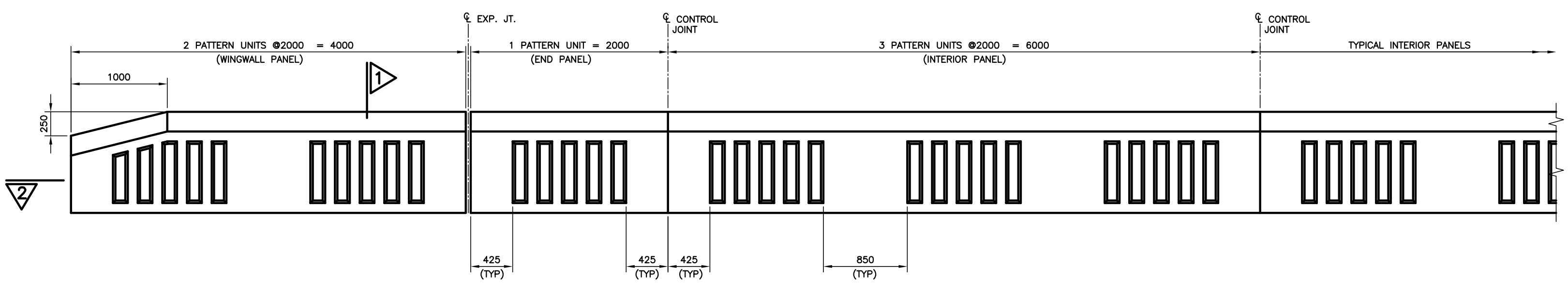




WINGWALL PANEL AS SHOWN: END AND INTERIOR PANELS SIMILAR

NOTES TO DESIGNER:

1. ARCHITECTURAL PATTERN UNIT LENGTH = 1500mm
2. WINGWALL AND END PANEL LENGTHS MUST BE MULTIPLES OF 0.5m; SUCH AS 0.5m, 1.0m, 1.5m, 2.0m . . . ETC.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



ELEVATION – BARRIER WALLS WITH ARCHITECTUAL TYPE-B FINISH

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:

SS110-70 BARRIER WALL WITH ARCHITECTURAL FINISH, TL-5

STANDARD DRAWING SEPTEMBER 2016	SS110-72
ARCHITECTURAL FINISH (TYPE B) FOR TL-5 BARRIER WALL	

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

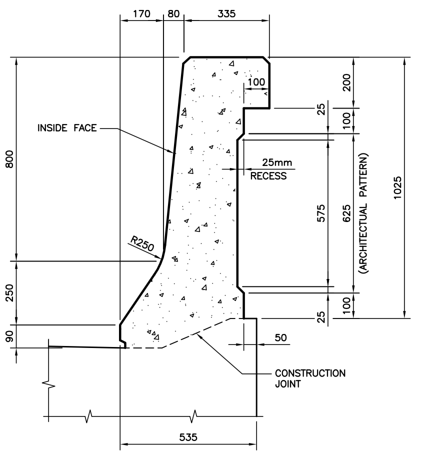
REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

ARCHITECTURAL FINISH (TYPE C) FOR TL-5 BARRIER WALL



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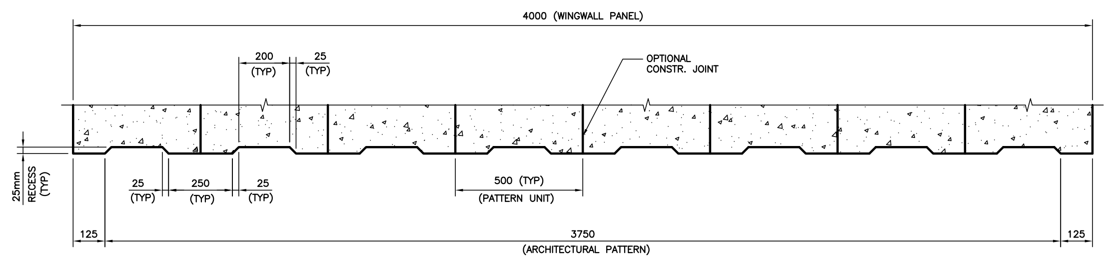
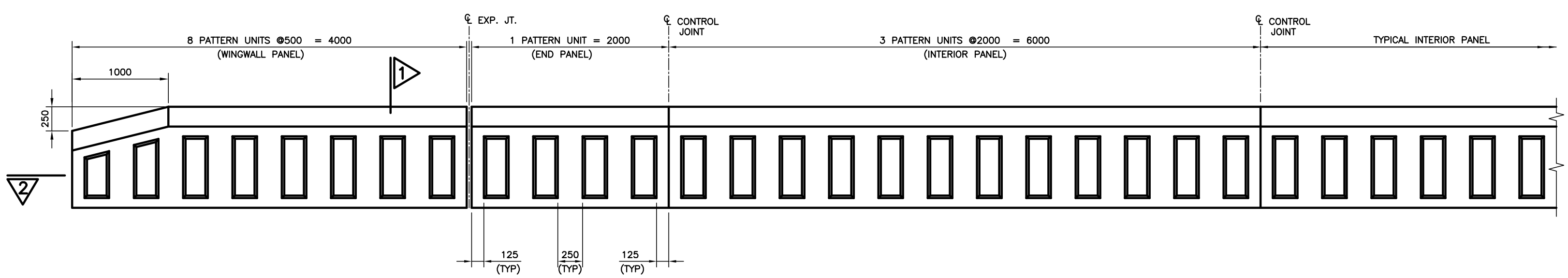


2

WINGWALL PANEL AS SHOWN: END AND INTERIOR PANELS SIMILAR

NOTES TO DESIGNER:
1. ARCHITECTURAL PATTERN UNIT LENGTH = 1500mm
2. WINGWALL AND END PANEL LENGTHS MUST BE MULTIPLES OF 0.5m; SUCH AS 0.5m, 1.0m, 1.5m, 2.0m . . . ETC.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



ELEVATION – BARRIER WALLS WITH ARCHITECTUAL TYPE-C FINISH

APPLICABLE STANDARD DRAWINGS
SS110-70 BARRIER WALL WITH ARCHITECTURAL FINISH, TL-5

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016

SS110-73

ARCHITECTURAL FINISH (TYPE C) FOR TL-5 BARRIER WALL

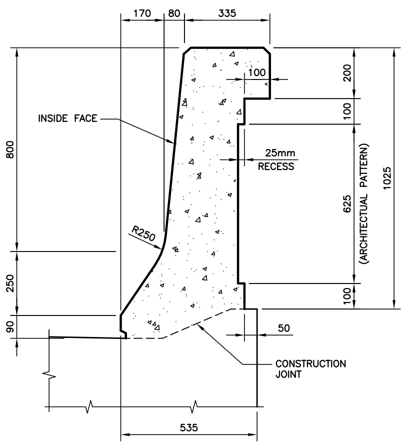
DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

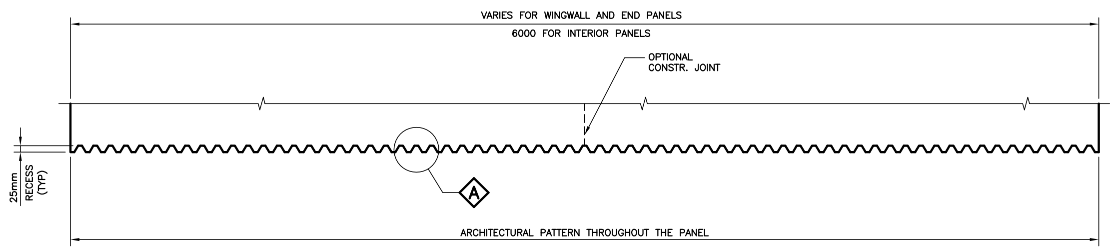
REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No	
WP No	
ARCHITECTURAL FINISH (TYPE D) FOR TL-5 BARRIER WALL	SHEET

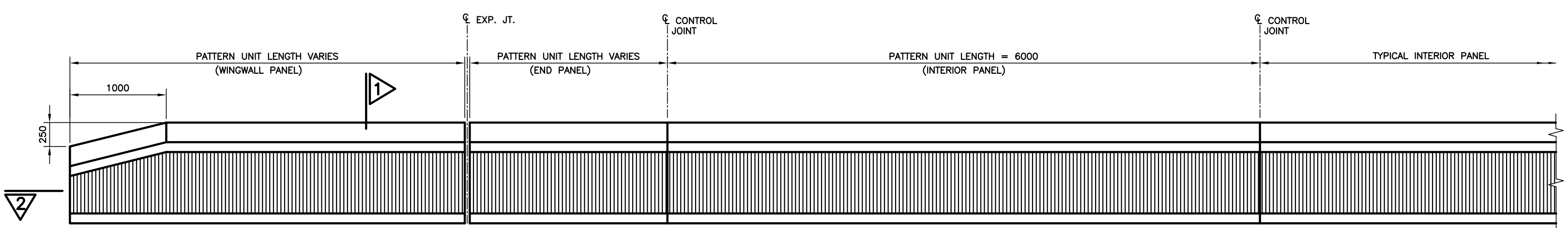




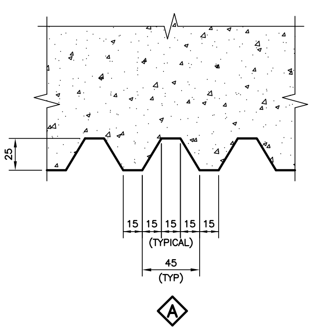
WINGWALL PANEL AS SHOWN; END AND INTERIOR PANELS SIMILAR

NOTE TO DESIGNER:

NO RESTRICTIONS ON ARCHITECTURAL PATTERN UNIT LENGTH FOR WINGWALL AND END PANELS.



ELEVATION – BARRIER WALLS WITH ARCHITECTUAL TYPE-D FINISH



ARCHITECTURAL PATTERN DETAIL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:

SS110-70 BARRIER WALL WITH ARCHITECTURAL FINISH, TL-5

STANDARD DRAWING SEPTEMBER 2016	SS110-74
ARCHITECTURAL FINISH (TYPE D) FOR TL-5 BARRIER WALL	

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

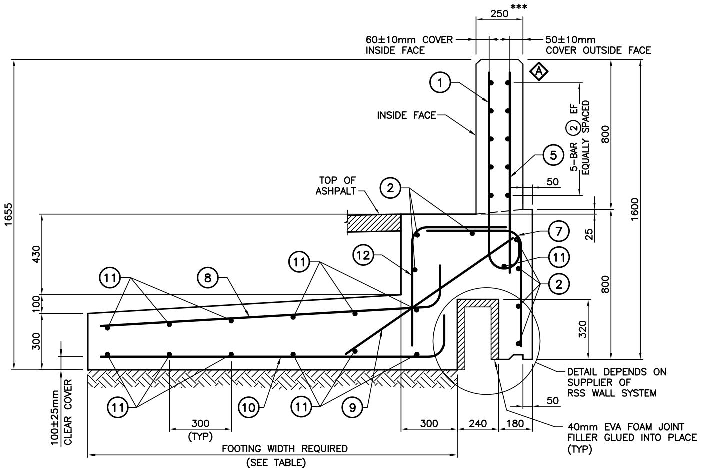
REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

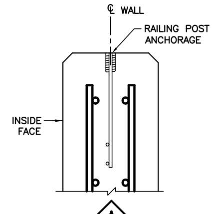
CONT No
WP No

SHEET

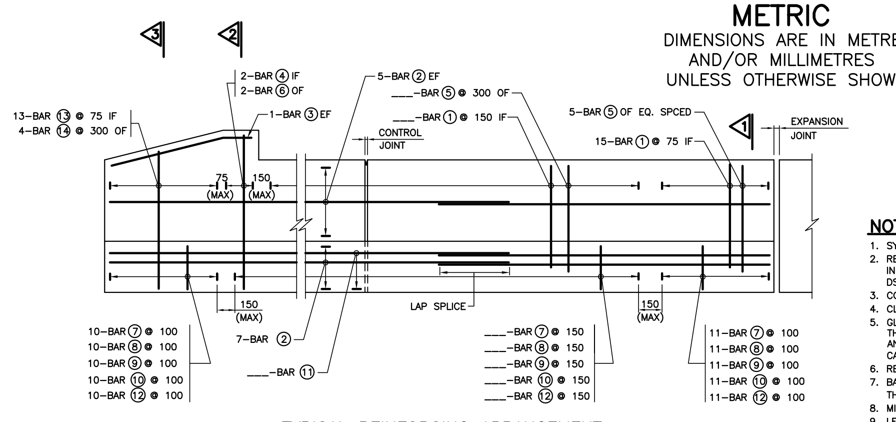
PARAPET WALL WITH RAILING ON RSS WALL, TL-4 (GFRP REBAR)



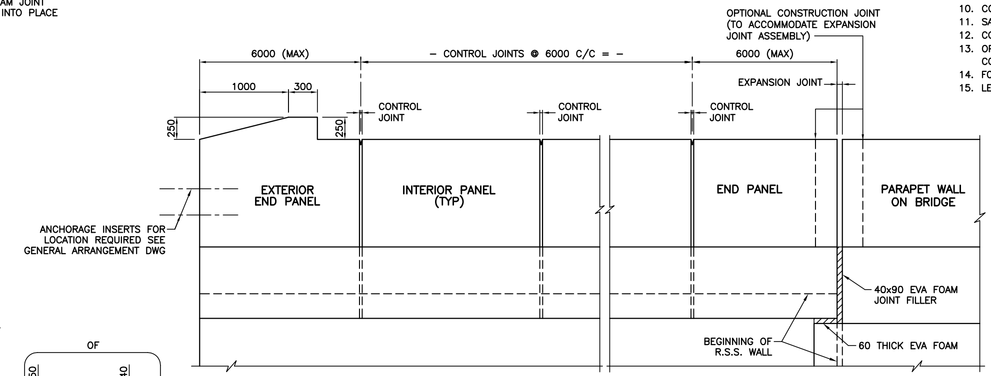
PARAPET WALL ON R.S.S. WALL
TYPICAL DIMENSIONS



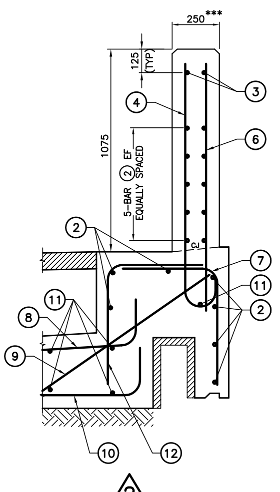
POST ANCHORAGE DETAIL

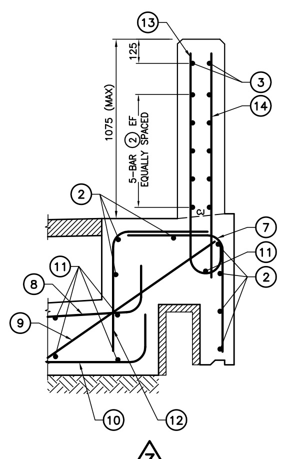


TYPICAL REINFORCING ARRANGEMENT

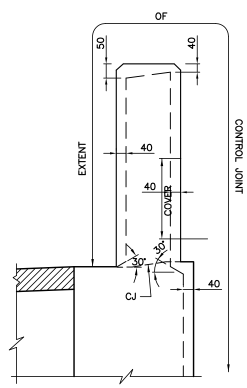


ELEVATION

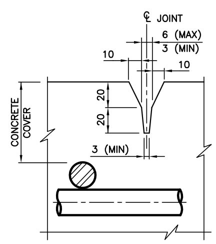




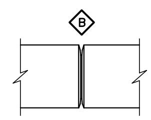
PARAPET WALL AT EXTERIOR END PANEL



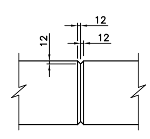
EXTENT OF CONTROL JOINT IN PARAPET WALL



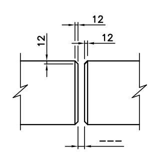
CONTROL JOINT DETAIL



TYPICAL CONTROL JOINT



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. RETAINED SOIL SYSTEM WALL, PARAPET WALL AND FOOTING, SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.70.56.
3. CONCRETE COVER TO REINFORCING BAR 70±20mm, EXCEPT AS NOTED.
4. CLASS OF CONCRETE FOR FOOTING 30 MPa.
5. GLASS FIBRE REINFORCED POLYMER(GFRP) SHALL BE GRADE I, SIZE IN THE BAR SCHEDULE INDICATES GRADE AND DESIGNATED BAR DIAMETERS AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
6. REINFORCING STEEL SHALL BE GRADE 400W
7. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
8. MINIMUM BAR LAP SPLICE TO BE 700mm, UNLESS OTHERWISE SHOWN.
9. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
10. CONTROL JOINT TO BE FORMED.
11. SAWCUTS NOT PERMITTED.
12. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
13. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL
14. FOOTINGS SHALL HAVE CONSTRUCTION JOINTS AT MAX SPACING OF 12.0M.
15. LEGEND: EF – DENOTES EACH FACE
IF – DENOTES INSIDE FACE
OF – DENOTES OUTSIDE FACE
CJ – CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	GI-20M	80, 190, 950
2	GI-15M	STRAIGHT
3	GI-15M	950, 250
4	GI-20M	80, 190, 1200
5	GI-15M	STRAIGHT
6	GI-15M	STRAIGHT
7	GI-15M	570, 650
8	GI-15M	3', 350, VARIES
9	GI-15M	STRAIGHT
10	15M	350, VARIES
11	15M	STRAIGHT
12	GI-15M	570, 650
13	GI-20M	80, 190, VARIES
14	GI-15M	STRAIGHT LENGTH VARIES

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

NOTES TO DESIGNER

1. THE DESIGNER SHALL SHOW DETAIL OF STUB WALL, AS IS COMMONLY REQUIRED, AT THE BEGINNING OF THE RSS WALL.
2. THE FOOTING WIDTH REQUIRED IS BASED ON THE FOOTING LENGTH FOR THIS PROJECT AS PER TABLE FOUND BELOW, AND SHALL BE FILLED IN ON THIS DRAWING BY THE DESIGNER.

	FOOTING LENGTH		
	≤6.0m	6.0m TO 15.0m	>15.0m
	*	**	**
FOOTING WIDTH REQUIRED	2500mm	2250mm	1750mm

* – WITH APPROACH SLAB
** – WITHOUT APPROACH SLAB

3. *** INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.
4. THIS DRAWING IS NOT SUITABLE FOR ANTICIPATED SETTLEMENT OF UNDERLYING SOIL LARGER THAN 25mm. FOR SUCH CASES, FOLLOW MTO RSS DESIGN GUIDELINES.
5. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

APPLICABLE STANDARD DRAWINGS:

SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016 — SS110-75

PARAPET WALL WITH RAILING ON RSS WALL, TL-4 (GFRP REBAR)

REVISIONS — DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

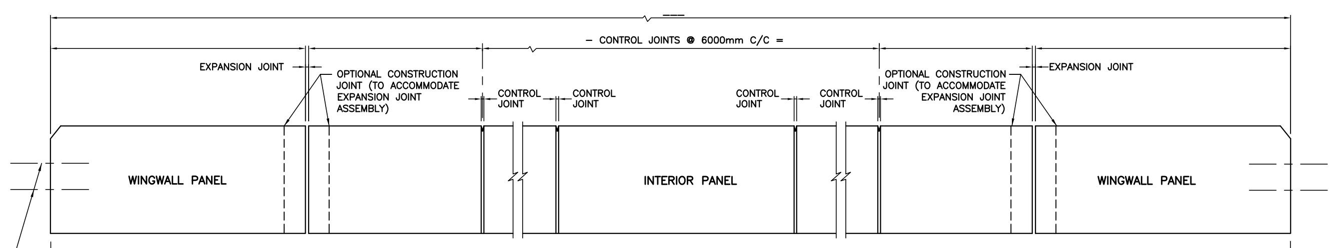
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

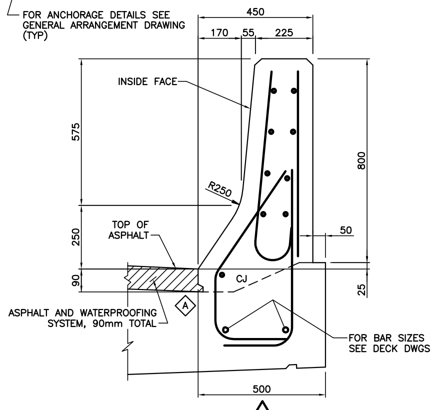
CONT No
WP No

SHEET

BARRIER WALL WITHOUT RAILING, TL-4 (STAINLESS STEEL REBAR)

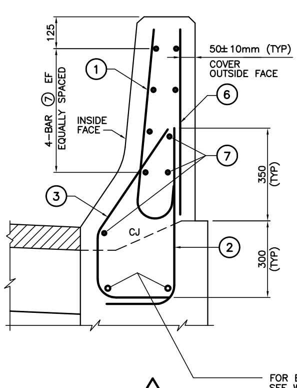


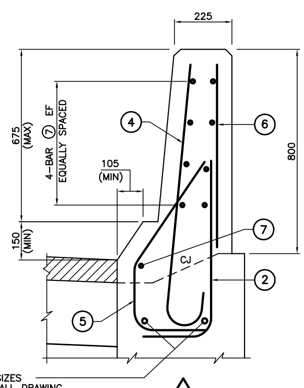
ELEVATION



1 BARRIER WALL ON DECK

TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

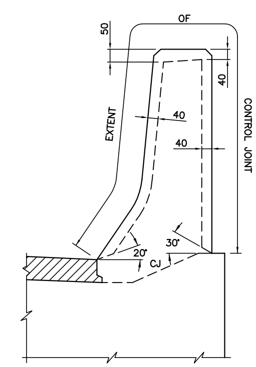




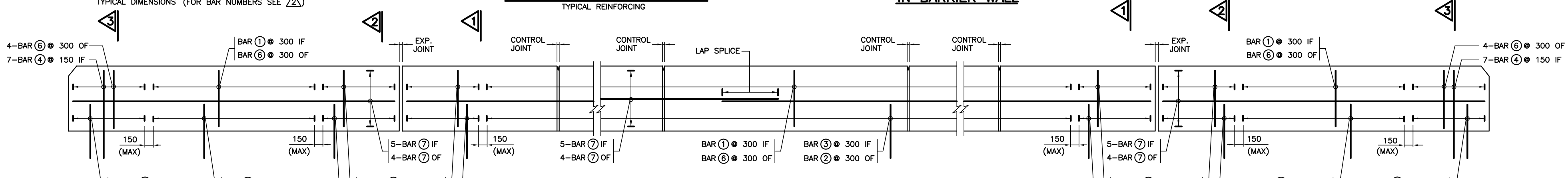
2 BARRIER WALL ON WINGWALL

TYPICAL REINFORCING

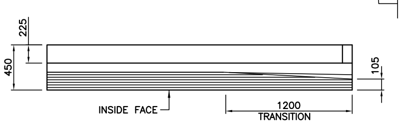
3



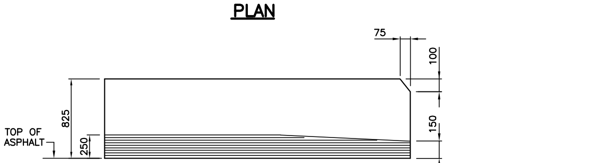
EXTENT OF CONTROL JOINT IN BARRIER WALL



TYPICAL REINFORCING ARRANGEMENT

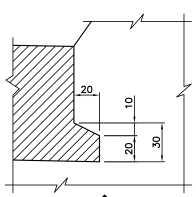


PLAN

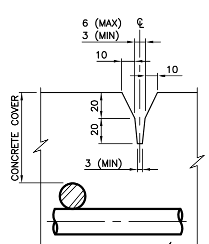


ELEVATION OF BARRIER WALL ON WINGWALL

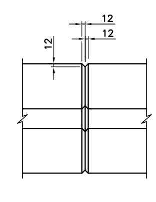
THIS FACE PERPENDICULAR TO GRADE OF ABUTTING GUIDE RAIL /OR CONCRETE BARRIER TRANSITION WALL



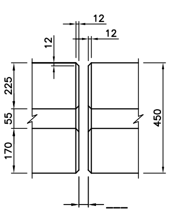
A CHASE DETAIL



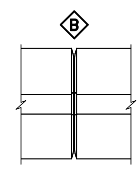
B CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT



TYPICAL CONTROL JOINT

BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 670
2	S10M	260, 650
3	S15M	280, 250, 500, 275
4	S15M	130, 65, 920
5	S15M	250, 240, 530, 300
6	S10M	STRAIGHT
7	S15M	STRAIGHT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
3. CONCRETE COVER TO REINFORCING STEEL 60±10mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. LEGEND:
    - EF – DENOTES EACH FACE
    - IF – DENOTES INSIDE FACE
    - OF – DENOTES OUTSIDE FACE
    - CJ – DENOTES CONSTRUCTION JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS110-80

BARRIER WALL WITHOUT RAILING, TL-4 (STAINLESS STEEL REBAR)

REVISIONS			
DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

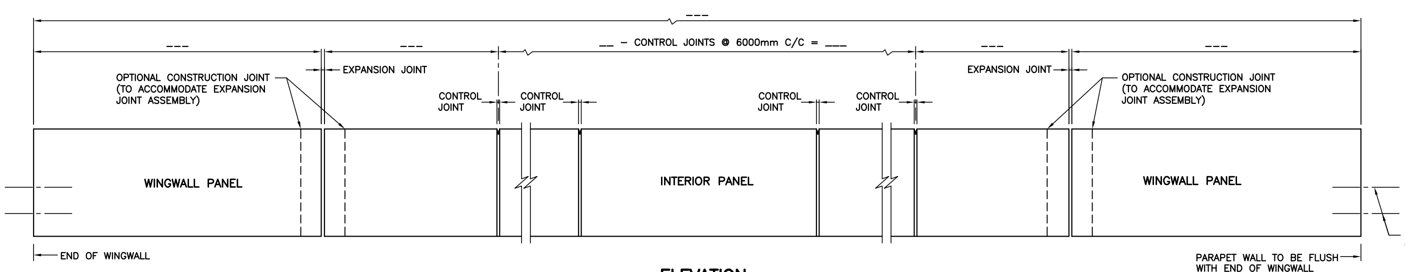
DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

CONT No
WP No

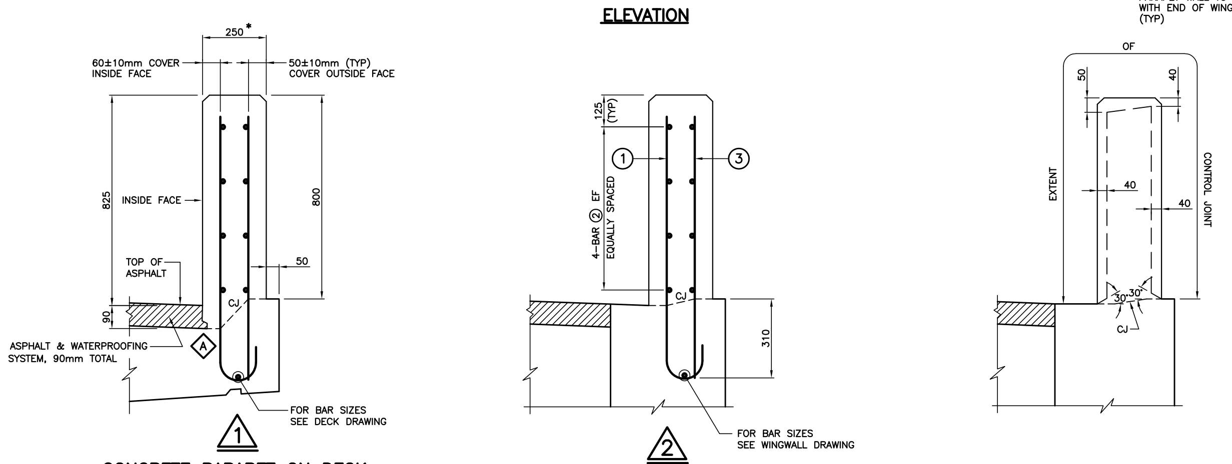
SHEET

PARAPET WALL WITHOUT RAILING, TL-4 (STAINLESS STEEL REBAR)

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



ELEVATION



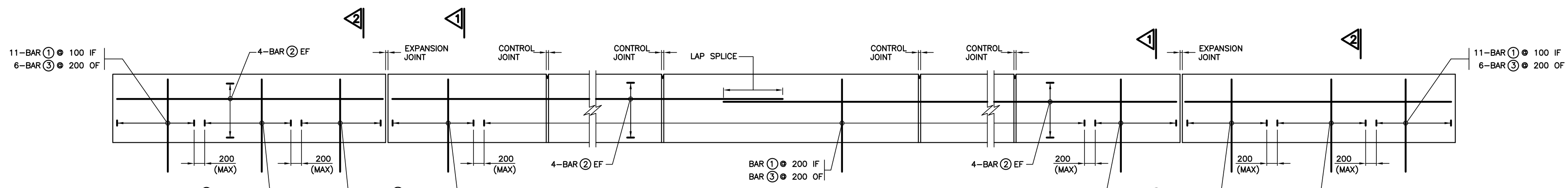
CONCRETE PARAPET ON DECK

TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

CONCRETE PARAPET ON WINGWALL

TYPICAL REINFORCEMENT

EXTENT OF CONTROL JOINT IN PARAPET WALL



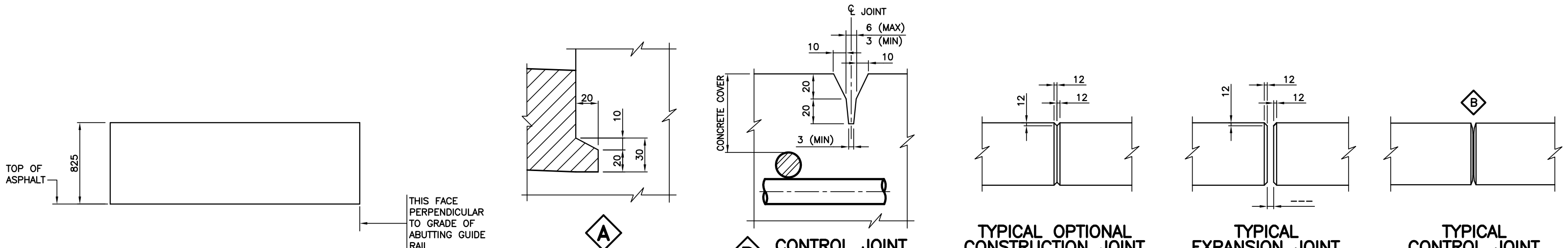
TYPICAL REINFORCING ARRANGEMENT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
3. CONCRETE COVER TO REINFORCING STEEL 60 ±10mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
9. CONTROL JOINT TO BE FORMED.
10. SAWCUTS NOT PERMITTED.
11. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
12. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
13. LEGEND:
    EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

*** NOTE TO DESIGNER**
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.

BAR MARK	SIZE	SHAPE
1	S15M	130 – 65 – 975
2	S15M	STRAIGHT
3	S10M	STRAIGHT



ELEVATION OF PARAPET ON WINGWALL

CHASE DETAIL

CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016

SS110-81

PARAPET WALL WITHOUT RAILING, TL-4 (STAINLESS STEEL REBAR)

REVISIONS					
		DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	LOAD		DATE
DRAWN	CHK	SITE			DWG

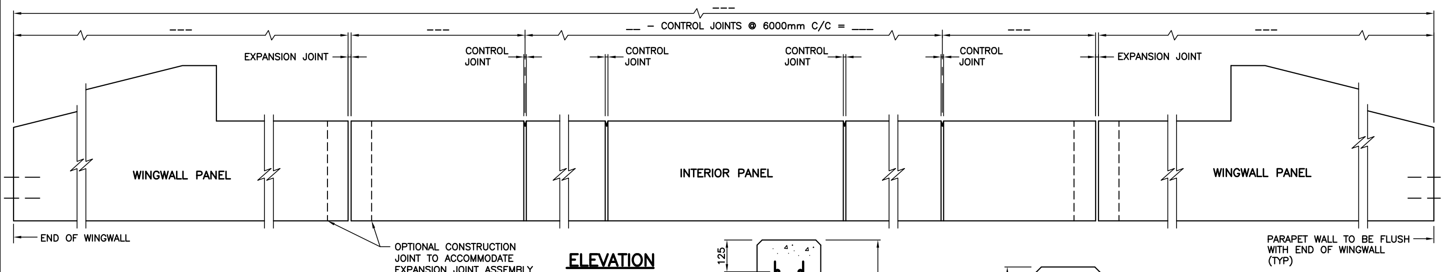
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

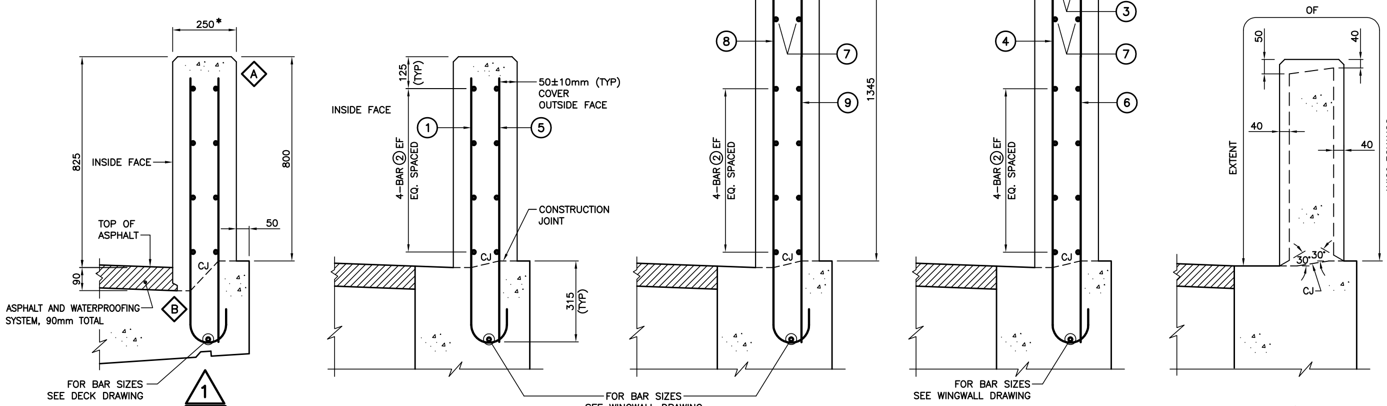
CONT No
WP No

PARAPET WALL FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4 (STAINLESS STEEL REBAR)

SHEET



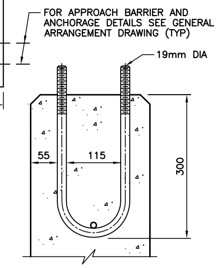
ELEVATION



CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS
(FOR BAR NUMBERS SEE 2)

CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCEMENT

EXTENT OF CONTROL JOINT IN PARAPET WALL



POST ANCHORAGE DETAIL
(SEE S110-85)

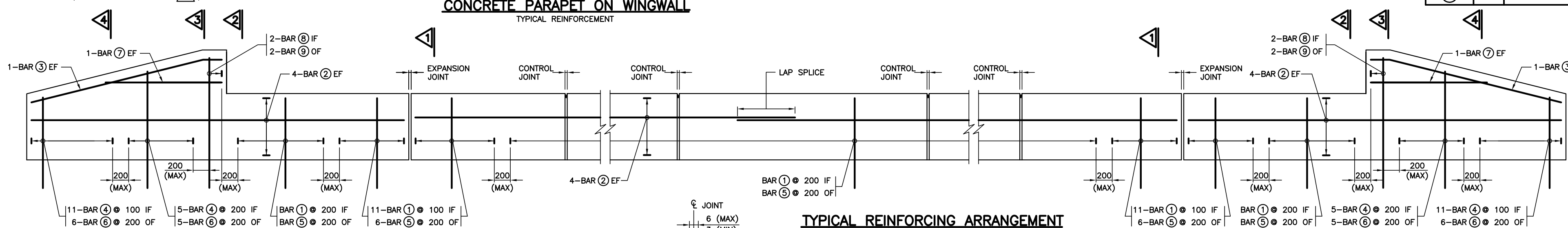
NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
3. CONCRETE COVER TO REINFORCING STEEL 60 ±10mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm UNLESS OTHERWISE SHOWN.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – DENOTES CONSTRUCTION JOINT

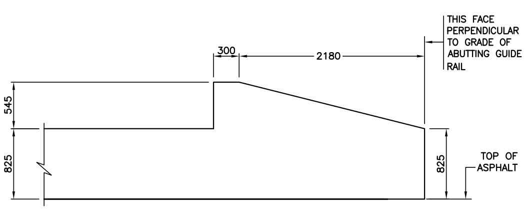
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

* NOTE TO DESIGNER
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA ELECTRICAL DUCTS ARE REQUIRED.

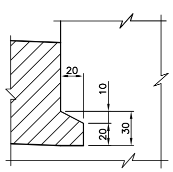
BAR MARK	SIZE	SHAPE
1	S15M	130, 65, 990
2	S15M	STRAIGHT
3	S15M	230, 2190, 530
4	S15M	130, 65, VARIES
5	S10M	STRAIGHT
6	S10M	STRAIGHT LENGTH VARIES
7	S15M	STRAIGHT
8	S15M	130, 65, 1535
9	S10M	STRAIGHT



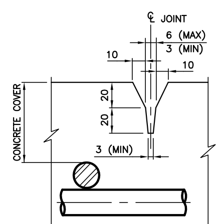
TYPICAL REINFORCING ARRANGEMENT



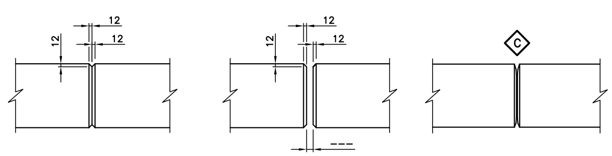
ELEVATION OF PARAPET ON WINGWALL



CHASE DETAIL



CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

APPLICABLE STANDARD DRAWINGS:

SS110-85 RAILING ON PARAPET/BARRIER FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4

STANDARD DRAWING SEPTEMBER 2016 — SS110-82

PARAPET WALL FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4 (STAINLESS STEEL REBAR)

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS — DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

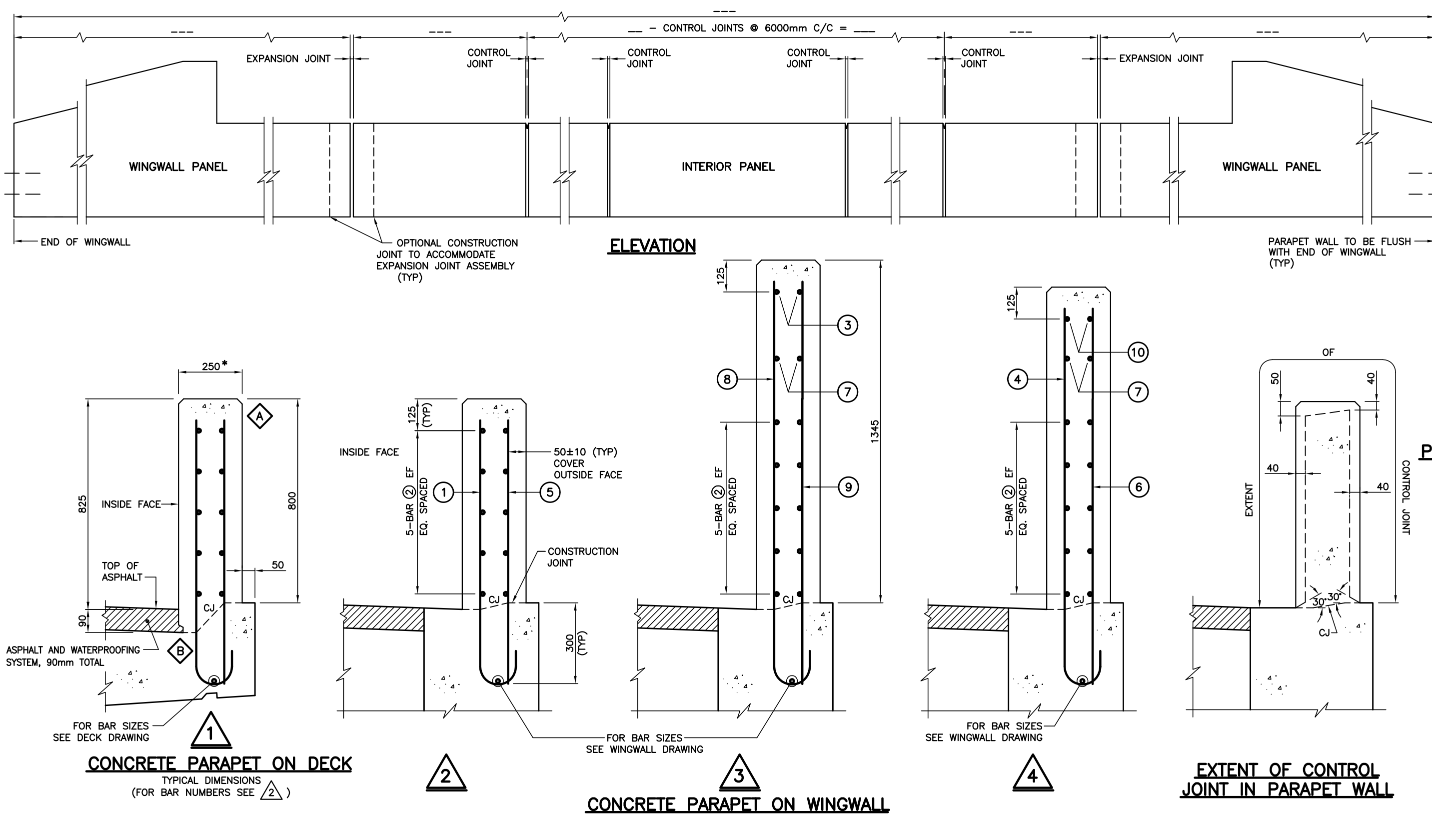
METRIC

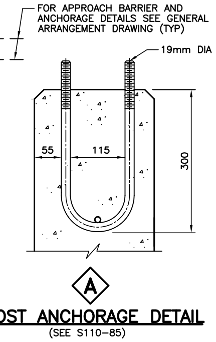
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

PARAPET WALL FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4 (GFRP REBAR)

SHEET





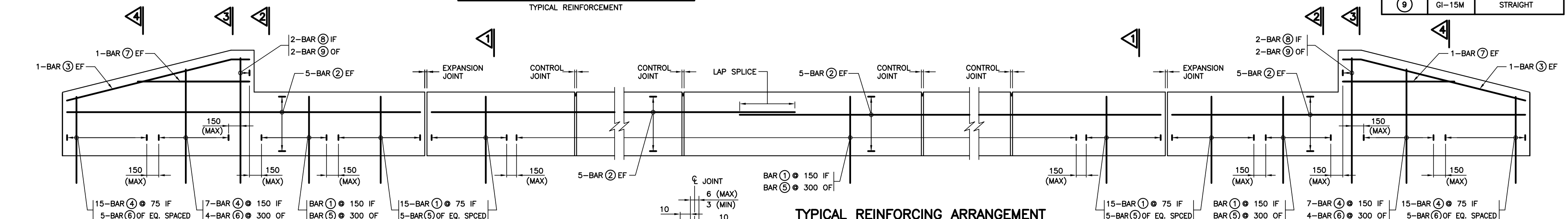
NOTES:

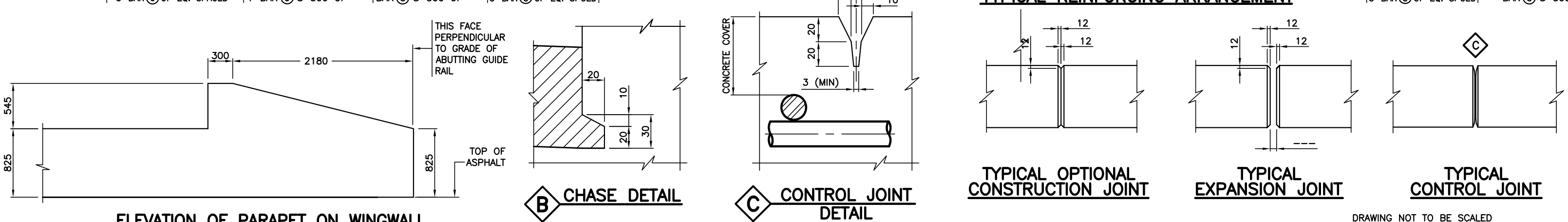
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE I. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110-84.
13. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	GI-20M	190, 80, 945
2	GI-15M	STRAIGHT
3	GI-15M	2190, 530, 230
4	GI-20M	190, 80, VARIES
5	GI-15M	STRAIGHT
6	GI-15M	STRAIGHT LENGTH VARIES
7	GI-15M	STRAIGHT
8	GI-20M	190, 80, 1490
9	GI-15M	STRAIGHT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

* NOTE TO DESIGNER
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA ELECTRICAL DUCTS ARE REQUIRED.





APPLICABLE STANDARD DRAWINGS:
SS110-85 RAILING ON PARAPET/BARRIER FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4

STANDARD DRAWING SEPTEMBER 2016 | SS110-83

PARAPET WALL FOR COMBINATION TRAFFIC/ BICYCLE RAIL, TL-4 (GFRP REBAR)

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

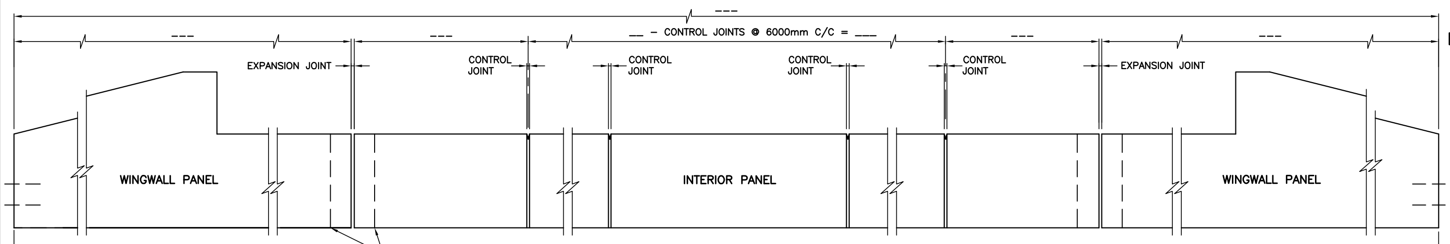
REVISIONS | DESCRIPTION
DESIGN | CHK | CODE CHBDC-14 | LOAD | DATE
DRAWN | CHK | SITE | DWG

METRIC

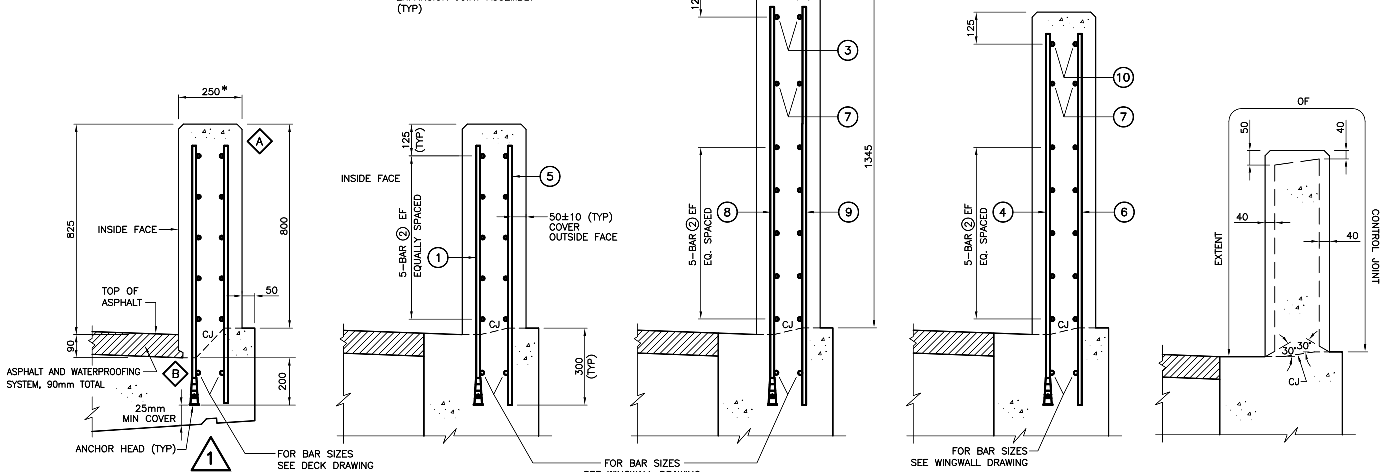
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No	
WP No	SHEET

PARAPET WALL FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4 (GFRP REBAR WITH ANCHOR HEAD)



ELEVATION



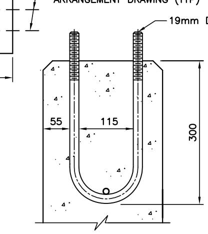
CONCRETE PARAPET ON DECK

TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

CONCRETE PARAPET ON WINGWALL

TYPICAL REINFORCEMENT

EXTENT OF CONTROL JOINT IN PARAPET WALL



POST ANCHORAGE DETAIL

(SEE S110-85)

BAR MARK	SIZE	SHAPE
1	GIII-15M WITH ANCHOR HEAD	STRAIGHT
2	GIII-15M	STRAIGHT
3	GIII-15M	STRAIGHT
4	GIII-15M WITH ANCHOR HEAD	STRAIGHT —VARIES—
5	GIII-13M	STRAIGHT
6	GIII-13M	STRAIGHT LENGTH VARIES
7	GIII-15M	STRAIGHT
8	GIII-15M WITH ANCHOR HEAD	STRAIGHT
9	GIII-13M	STRAIGHT
10	GIII-15M	STRAIGHT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE III. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
4. ANCHOR HEAD OF GFRP REBAR SHALL HAVE A MINIMUM GUARANTEED PULL OUT STRENGTH (Fp) AS FOLLOWS:

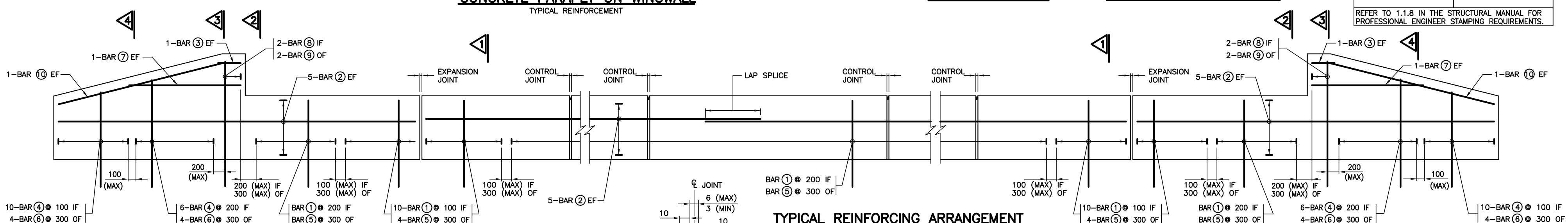
SIZE	Fp (kN)
GIII-15M WITH ANCHOR HEAD	100

5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT
14. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110-83.

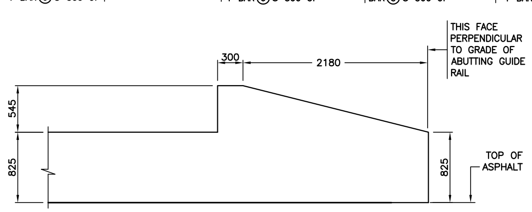
*** NOTE TO DESIGNER**

INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA ELECTRICAL DUCTS ARE REQUIRED.

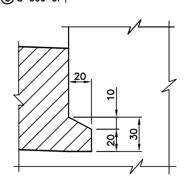
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.



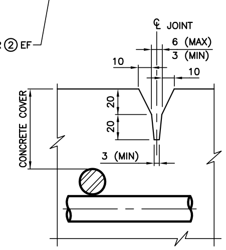
TYPICAL REINFORCING ARRANGEMENT



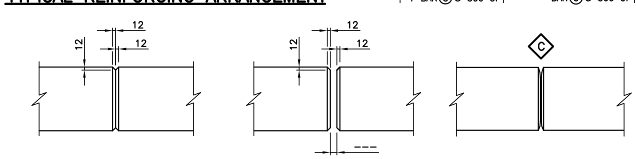
ELEVATION OF PARAPET ON WINGWALL



B CHASE DETAIL



C CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

APPLICABLE STANDARD DRAWINGS:

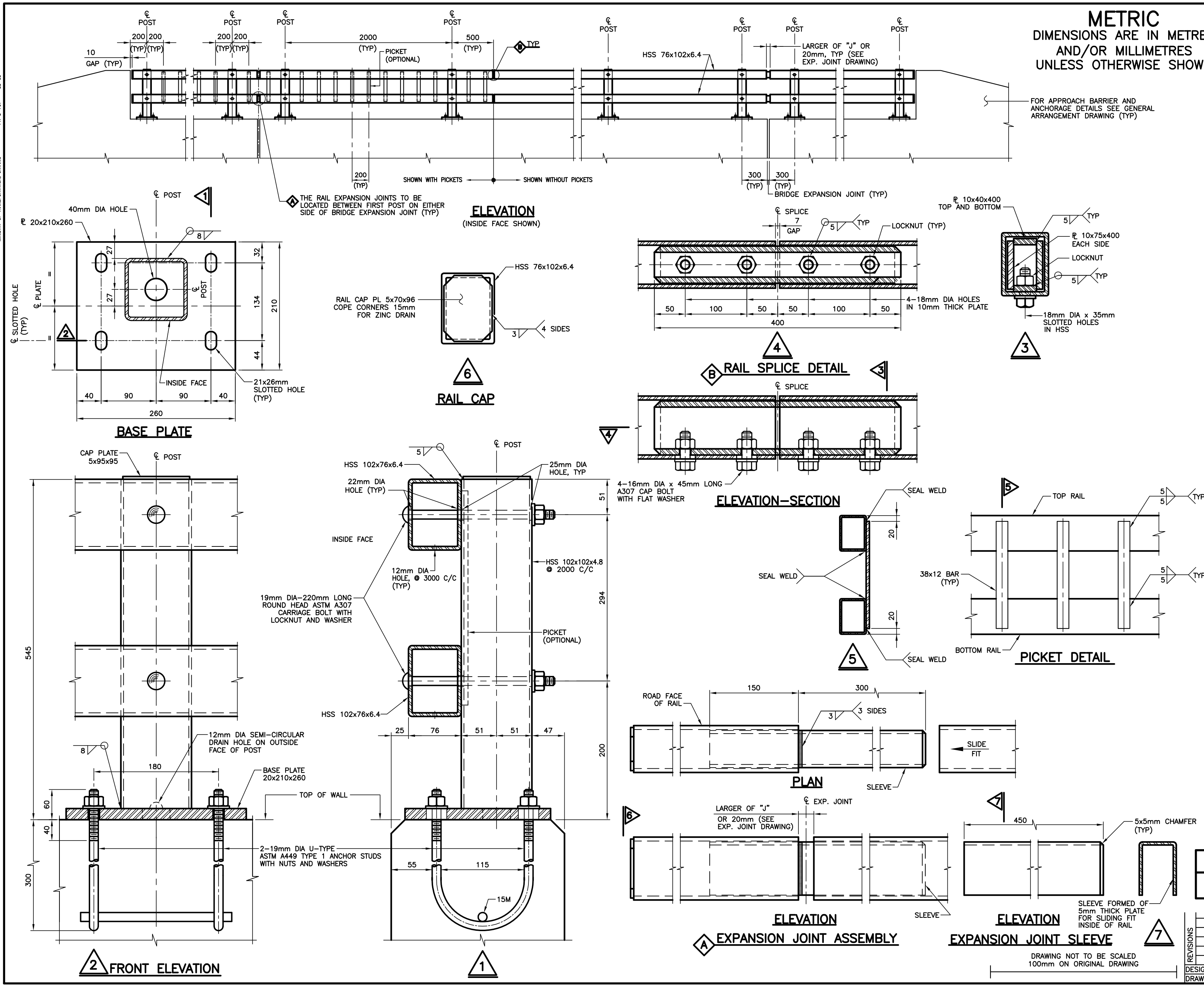
SS110-85 RAILING ON PARAPET/BARRIER FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4

STANDARD DRAWING SEPTEMBER 2016	SS110-84

PARAPET WALL FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4 (GFRP REBAR WITH ANCHOR HEAD)

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No WP No	
RAILING ON PARAPET FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4	SHEET

NOTES:

1. THIS STANDARD TO BE READ IN CONJUNCTION WITH SS110-__.
2. RAIL ELEMENTS AND POSTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350W, CLASS C.
3. STEEL PLATES SHALL BE GRADE 350W.
4. ANCHOR STUDS, WASHERS AND NUTS SHALL BE ACCORDING TO ASTM A449.
5. BOLTS, WASHERS AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL CONFORM TO ASTM A307.
6. RAIL SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT THIS. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
7. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15 mm TO ENSURE SLIDING FIT.
8 RAIL, POSTS AND RAIL SPLICES SHALL BE HOT DIP GALVANIZED. ALL GALVANIZING SHALL BE DONE AFTER FABRICATION.
9. BOLTS, ANCHOR STUDS, PLATES, WASHERS AND NUTS SHALL BE HOT DIP GALVANIZED. LOCKNUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
10. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150 METRES.
11. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
12. RAIL MAY BE CUT AS REQUIRED IN FIELD. CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR APPROVED EQUIVALENT.
13. WHEN CONNECTING TO EXISTING RAILING, RAIL MUST BE MADE CONTINUOUS AND POST SPACING DETERMINED WITH REFERENCE TO EXISTING POSTS.
14. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
15. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.
16. HOLES FOR HSS RAILING SHALL BE DRILLED IN FIELD
17. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN

ADDITIONAL NOTES FOR PICKET:

1. PICKET SHALL BE 38x12 STEEL BAR GRADE 300W.
2. HOT DIP GALVANIZING OF RAILING SHALL BE AFTER ADDITION OF PICKETS.

NOTES TO DESIGNER:

1. PICKETS ARE OPTIONAL FOR AESTHTIC PURPOSE. DESIGNER SHALL INDICATE IF PICKETS SHALL BE USED.
2. THE NOTES TO DESIGNER SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016	SS110-85
RAILING ON PARAPET FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4	

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

REVISIONS		DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14	DATE
DRAWN	CHK	SITE	DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

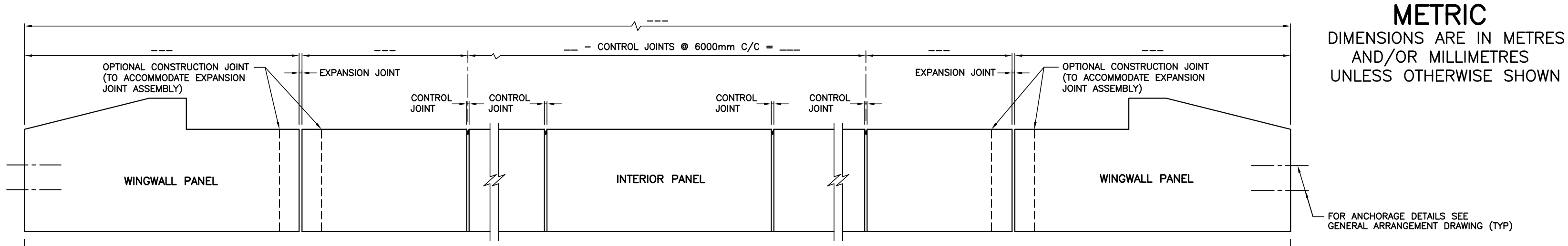
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

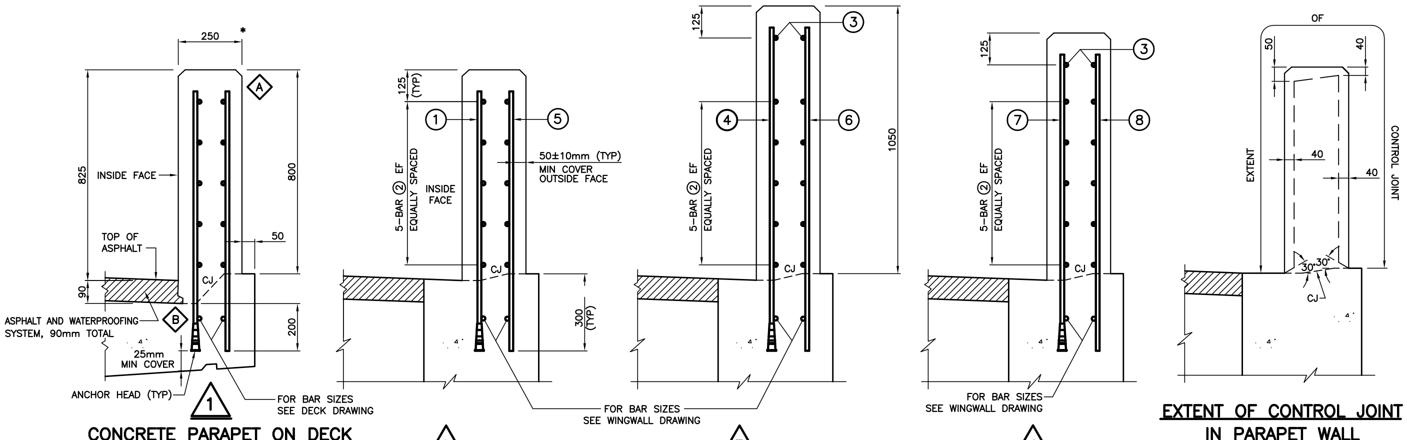
CONT No
WP No

SHEET

PARAPET WALL WITH RAILING, TL-4 (GFRP REBAR WITH ANCHOR HEAD)



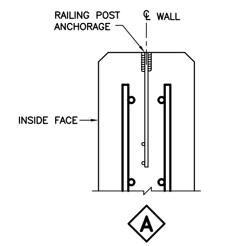
ELEVATION



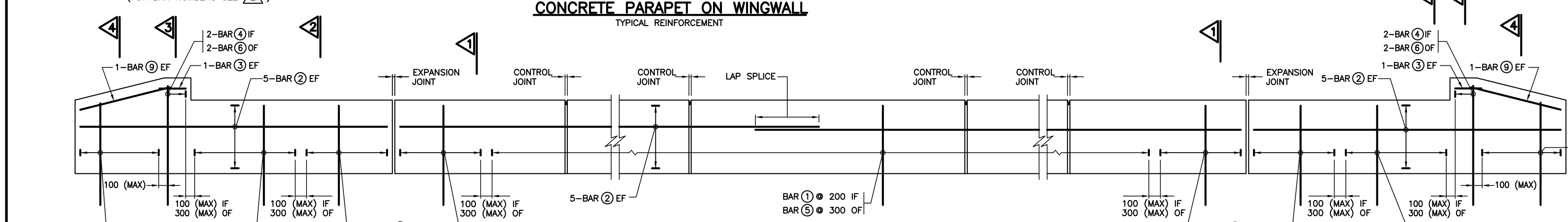
CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS
(FOR BAR NUMBERS SEE 2)

CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCEMENT

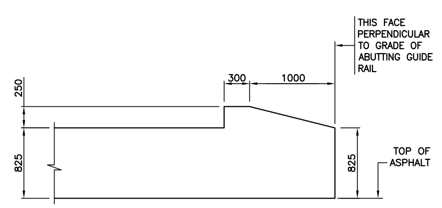
EXTENT OF CONTROL JOINT IN PARAPET WALL



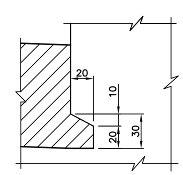
POST ANCHORAGE DETAIL



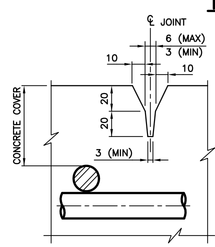
TYPICAL REINFORCING ARRANGEMENT



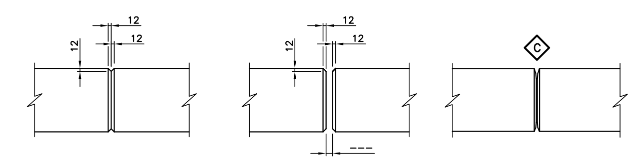
ELEVATION OF PARAPET ON WINGWALL



B CHASE DETAIL



C CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE III.SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
4. ANCHOR HEAD OF GFRP REBAR SHALL HAVE A MINIMUM GUARANTEED PULL OUT STRENGTH (Fp) AS FOLLOWS:

SIZE	Fp (kN)
GIII-15M WITH HEAD	100

5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110-59.
13. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
14. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	GIII-15M WITH ANCHOR HEAD	STRAIGHT
2	GIII-15M	STRAIGHT
3	GIII-15M	STRAIGHT
4	GIII-15M WITH ANCHOR HEAD	STRAIGHT
5	GIII-13M	STRAIGHT
6	GIII-13M	STRAIGHT
7	GIII-15M WITH ANCHOR HEAD	STRAIGHT —VARIES—
8	GIII-13M	STRAIGHT LENGTH VARIES
9	GIII-15M	STRAIGHT

*NOTES TO DESIGNER:

1. INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.
2. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:

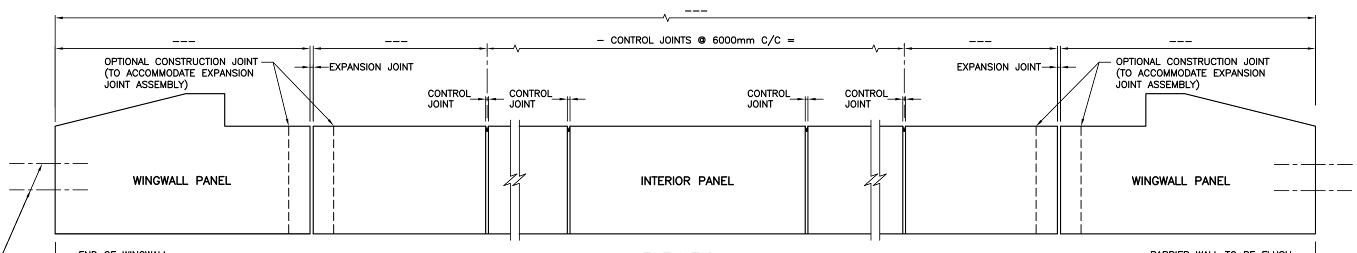
SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016 — SS110-90

PARAPET WALL WITH RAILING, TL-4 (GFRP REBAR WITH ANCHOR HEAD)

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG



ELEVATION

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

BAR MARK	SIZE	SHAPE
1	GIII–15M	STRAIGHT
2	GIII–15M WITH ANCHOR HEAD	STRAIGHT
3	GIII–13M	STRAIGHT
4	GIII–15M	STRAIGHT
5	GIII–15M	STRAIGHT
6	GIII–15M	STRAIGHT
7	GIII–13M	STRAIGHT
8	GIII–15M	STRAIGHT LENGTH VARIES
9	GIII–13M	STRAIGHT LENGTH VARIES
10	GIII–15M	STRAIGHT

CONT No
WP No

SHEET

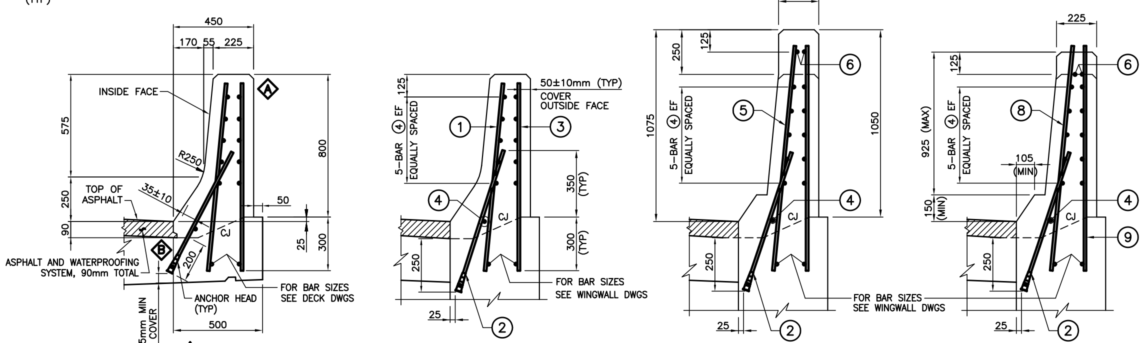
BARRIER WALL WITH RAILING, TL–4 (GFRP REBAR WITH ANCHOR HEAD)

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE III. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S–807.
4. ANCHOR HEAD OF GFRP REBAR SHALL HAVE A MINIMUM GUARANTEED PULL OUT STRENGTH (Fp) AS FOLLOWS:

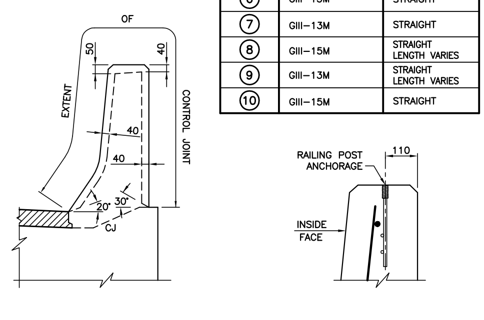
SIZE	Fp (kN)
GIII–15M WITH HEAD	100

5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110–58.
13. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
14. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



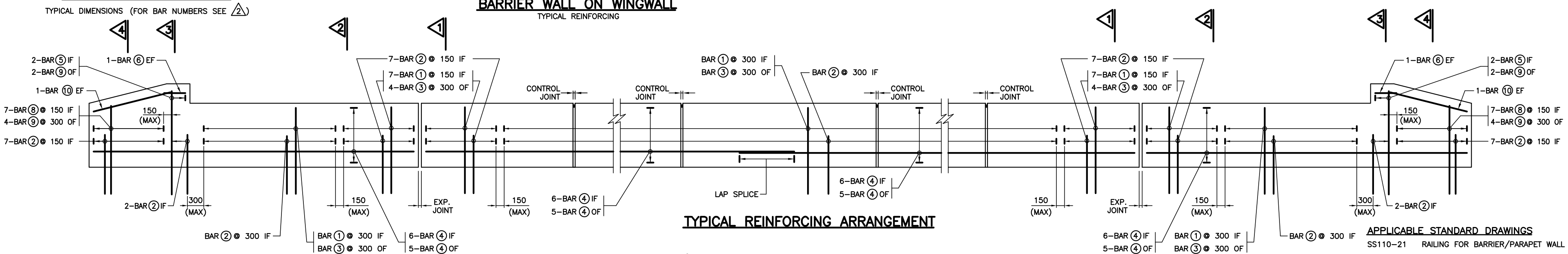
1 BARRIER WALL ON DECK
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

2 3 4 BARRIER WALL ON WINGWALL
TYPICAL REINFORCING



EXTENT OF CONTROL JOINT IN BARRIER WALL

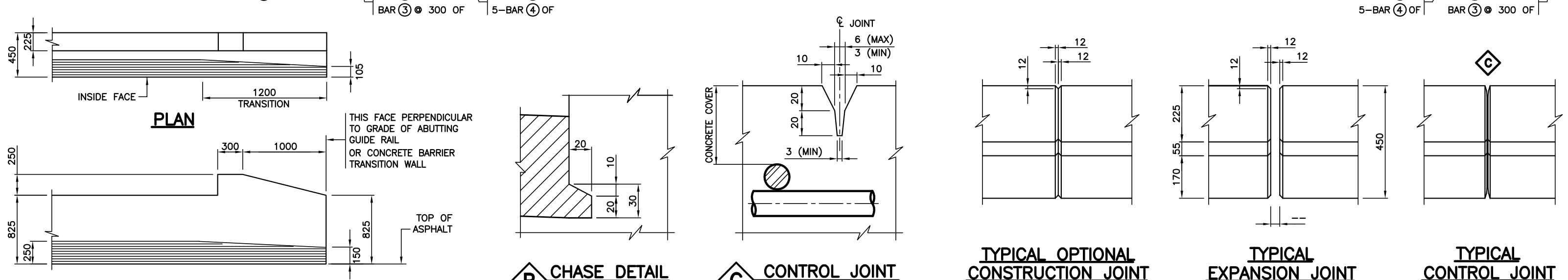
A POST ANCHORAGE DETAIL



TYPICAL REINFORCING ARRANGEMENT

APPLICABLE STANDARD DRAWINGS
SS110–21 RAILING FOR BARRIER/PARAPET WALL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.



PLAN

ELEVATION OF BARRIER WALL ON WINGWALL

B CHASE DETAIL

C CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

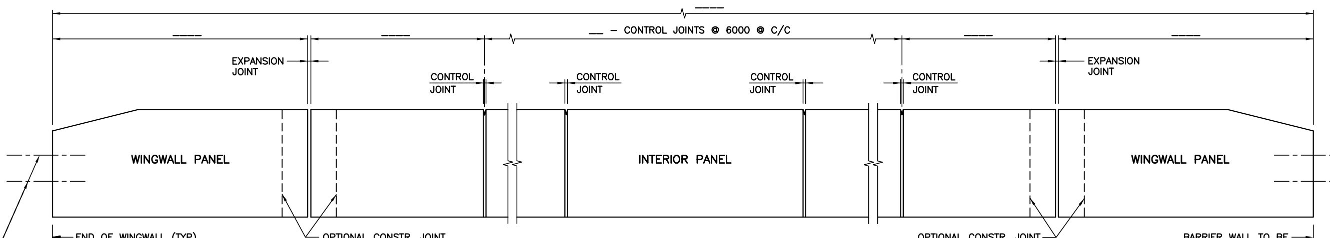
TYPICAL CONTROL JOINT

STANDARD DRAWING
SEPTEMBER 2016

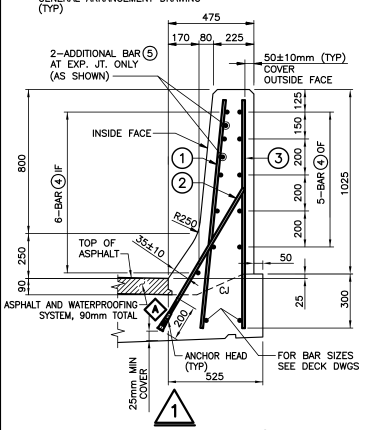
SS110–91

BARRIER WALL WITH RAILING, TL–4 (GFRP REBAR WITH ANCHOR HEAD)

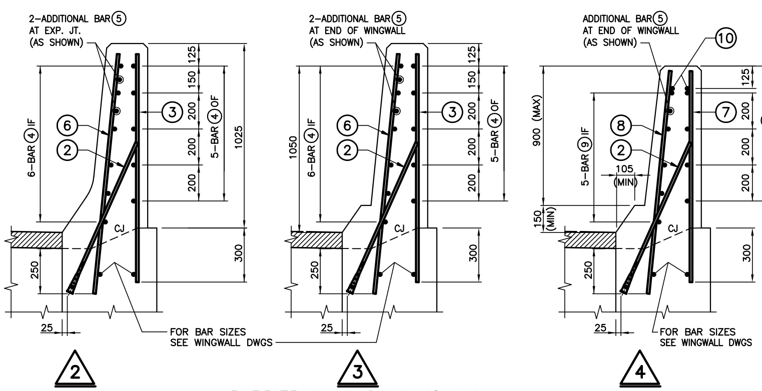
REVISIONS	DESCRIPTION			
DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG



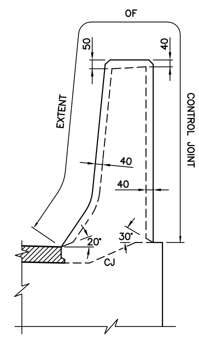
ELEVATION



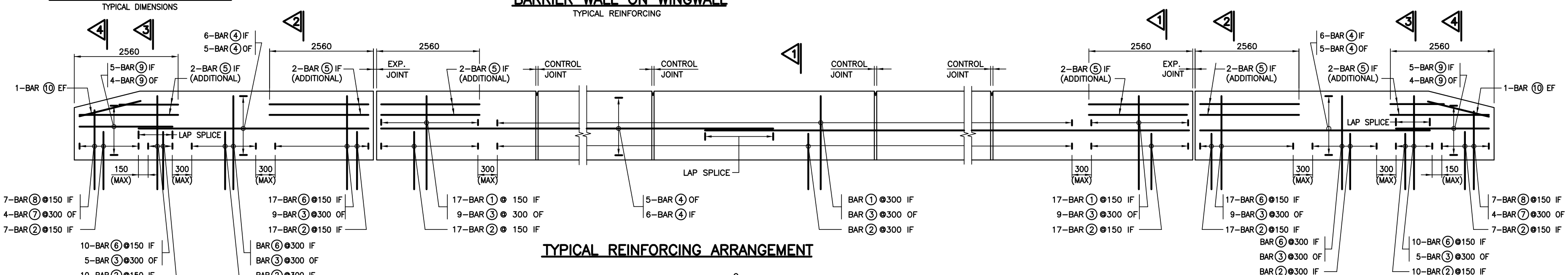
BARRIER WALL ON DECK
TYPICAL DIMENSIONS



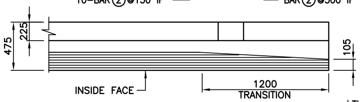
BARRIER WALL ON WINGWALL
TYPICAL REINFORCING



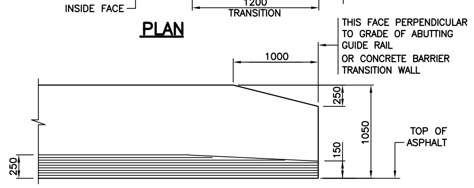
EXTENT OF CONTROL JOINT IN BARRIER WALL



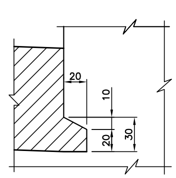
TYPICAL REINFORCING ARRANGEMENT



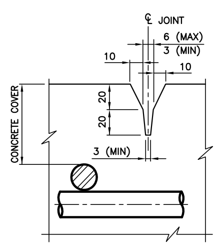
PLAN



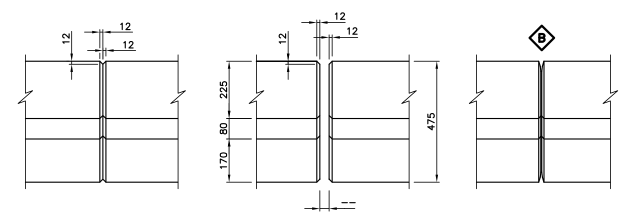
ELEVATION OF BARRIER WALL ON WINGWALL



A CHASE DETAIL



B CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

BARRIER WALL WITHOUT RAILING, TL-5 (GFRP REBAR WITH ANCHOR HEAD)

BAR MARK	SIZE	SHAPE
1	GIII–15M	STRAIGHT
2	GIII–15M WITH ANCHOR HEAD	910 STRAIGHT
3	GIII–13M	STRAIGHT
4	GIII–15M	STRAIGHT
5	GIII–15M	STRAIGHT
6	GIII–15M	STRAIGHT
7	GIII–13M	STRAIGHT LENGTH VARIES
8	GIII–15M	STRAIGHT LENGTH VARIES
9	GIII–13M	STRAIGHT
10	GIII–15M	STRAIGHT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GRADE III (GIII) GLASS FIBRE REINFORCED POLYMER (GFRP) SUPPLIED AS COMBAR BY SCHÖCK OR AS V-ROD HEADED BAR BY PULTRALL.
4. SIZE IN THE BAR SCHEDULE INDICATES DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
5. ANCHOR HEAD OF GFRP REBAR SHALL HAVE A MINIMUM GUARANTEED PULL OUT STRENGTH (Fp) AS FOLLOWS:

SIZE	Fp (kN)
GIII–15M WITH HEAD	100

6. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
7. MINIMUM BAR LAP SPLICE TO BE 640mm, UNLESS OTHERWISE SHOWN.
8. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
9. CONTROL JOINT TO BE FORMED.
10. SAWCUTS NOT PERMITTED.
11. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
12. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
13. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
14. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS110-92

BARRIER WALL WITHOUT RAILING, TL-5 (GFRP REBAR WITH ANCHOR HEAD)

REVISIONS		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

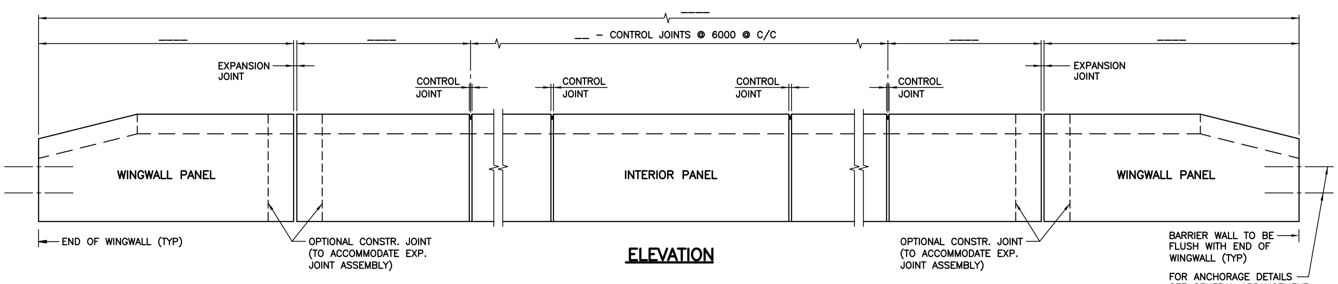
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

BARRIER WALL WITH ARCHITECTURAL FINISH, TL–5 (GFRP REBAR WITH ANCHOR HEAD)



ELEVATION

NOTES TO DESIGNER

1. THE ARCHITECTURAL FINISH OF THE SURFACE SHOWN SHALL BE AS SPECIFIED BY THE REGION.
2. FOR STANDARD ARCHITECTURAL FINISHES SEE DRAWINGS SS110–71, SS110–72, SS110–73, AND SS110–74.
3. THE RUSTIFICATION SPECIFIED SHALL NOT REDUCE THE COVER BY MORE THAN 25mm.
4. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

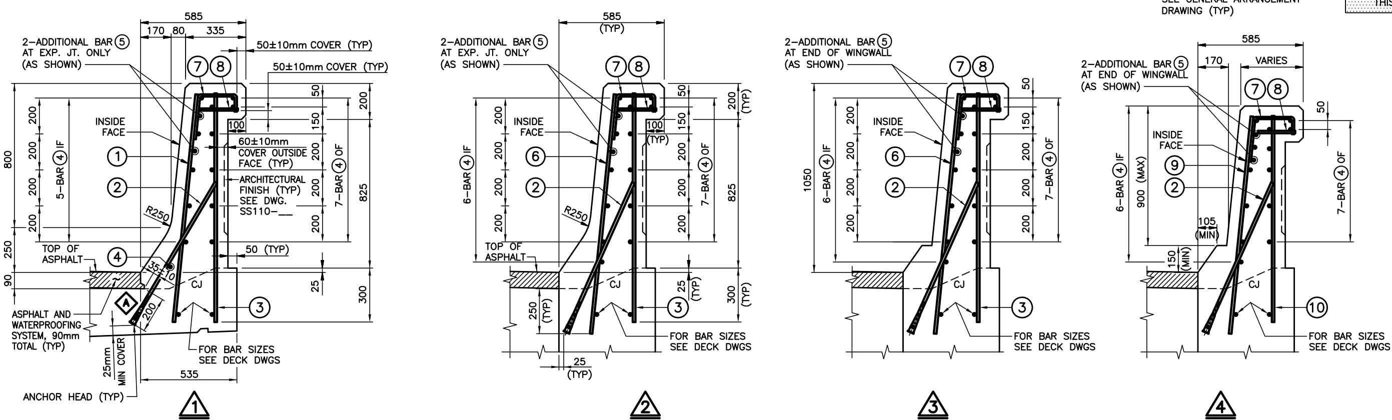
NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GRADE III (GIII) GLASS FIBRE REINFORCED POLYMER (GFRP) SUPPLIED AS COMBAR BY SCHÖCK OR AS V–ROD HEADED BAR BY PULTRALL.
4. SIZE IN THE BAR SCHEDULE INDICATES DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S–807.
5. ANCHOR HEAD OF GFRP REBAR SHALL HAVE A MINIMUM GUARANTEED PULL OUT STRENGTH (Fp) AS FOLLOWS:

SIZE	Fp (kN)
GIII–15M WITH HEAD	100

6. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
7. MINIMUM BAR LAP SPLICE TO BE 640mm, UNLESS OTHERWISE SHOWN.
8. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
9. CONTROL JOINT TO BE FORMED.
10. SAWCUTS NOT PERMITTED.
11. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
12. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
13. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
14. LEGEND:
    EF – DENOTES EACH FACE; OF – DENOTES OUTSIDE FACE
    IF – DENOTES INSIDE FACE; CJ – CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	GIII–15M	STRAIGHT
2	GIII–15M WITH ANCHOR HEAD	STRAIGHT 910
3	GIII–13M	STRAIGHT
4	GIII–15M	STRAIGHT
5	GIII–15M	STRAIGHT
6	GIII–15M	STRAIGHT
7	GIII–13M	250 VARIES 80
8	GIII–13M	230
9	GIII–15M	STRAIGHT LENGTH VARIES
10	GIII–13M	STRAIGHT LENGTH VARIES

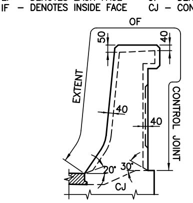


1 BARRIER WALL ON DECK
TYPICAL DIMENSIONS

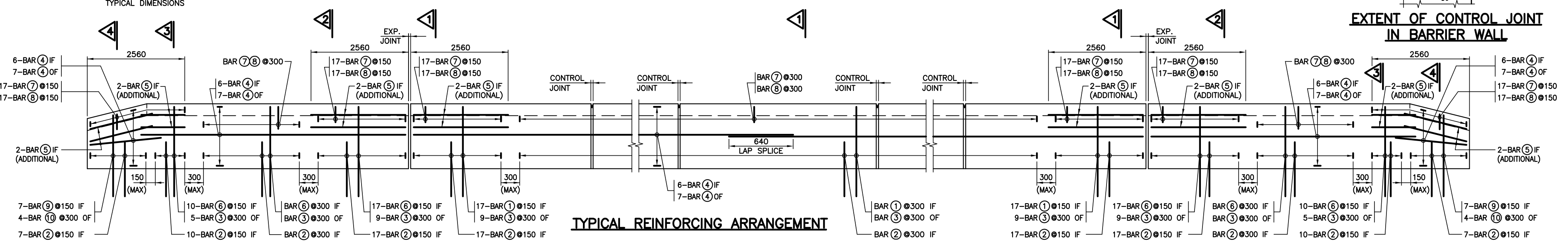
2

3 BARRIER WALL ON WINGWALL

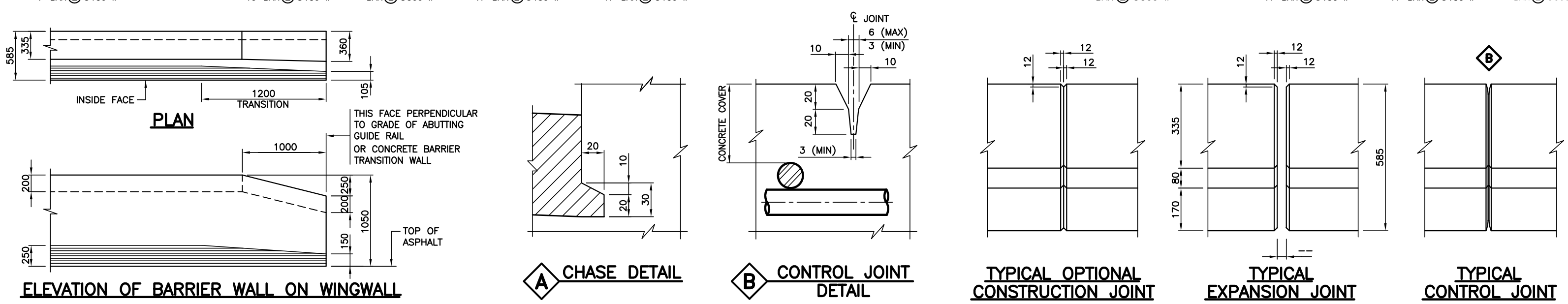
4



EXTENT OF CONTROL JOINT IN BARRIER WALL



TYPICAL REINFORCING ARRANGEMENT



PLAN

ELEVATION OF BARRIER WALL ON WINGWALL

A CHASE DETAIL

B CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
SEPTEMBER 2016

SS110–93

BARRIER WALL WITH ARCHITECTURAL FINISH, TL–5 (GFRP REBAR WITH ANCHOR HEAD)

REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG

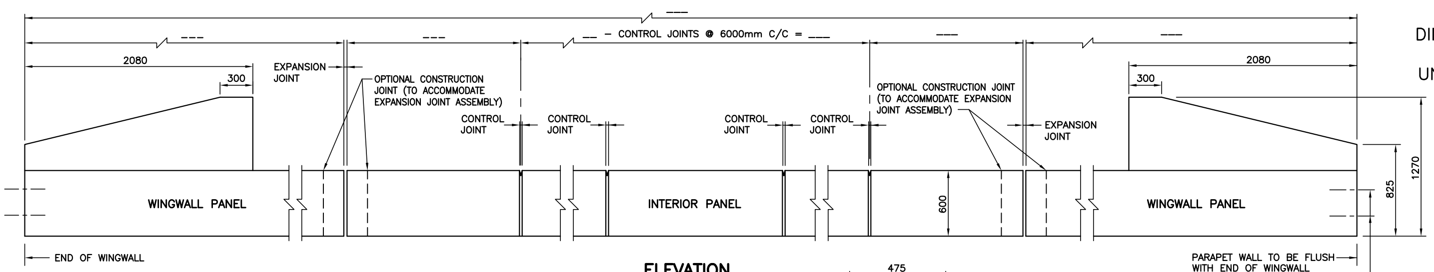
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

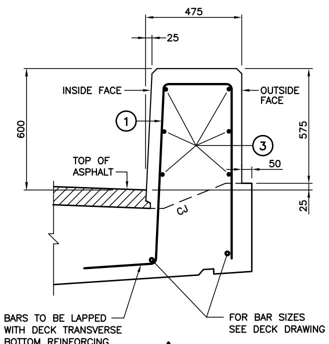
CONT No
WP No

PARAPET WALL FOR TWO TUBE RAILING, TL-5 (STAINLESS STEEL REBAR)

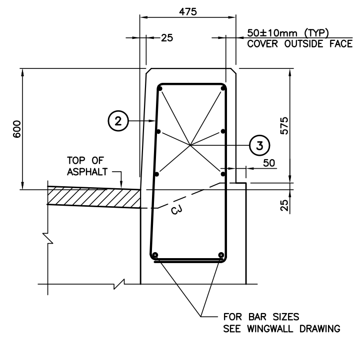
SHEET



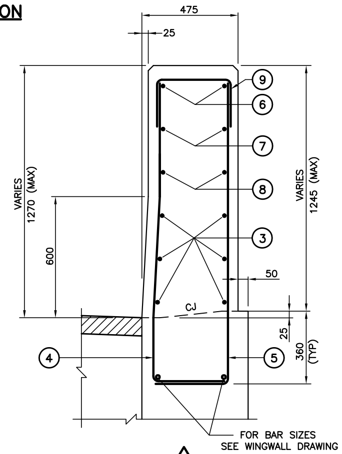
ELEVATION



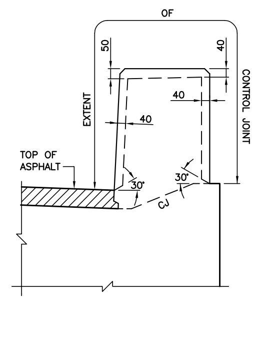
CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS AND REINFORCING



CONCRETE PARAPET ON WINGWALL
TYPICAL DIMENSIONS AND REINFORCING



CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCING



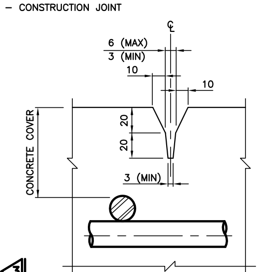
EXTENT OF CONTROL JOINT IN PARAPET WALL

BAR MARK	SIZE	SHAPE
1	S15M	350, *, 365
2	S15M	405, 365, 875
3	S15M	STRAIGHT
4	S15M	VARIES, 600, 335, 350
5	S15M	350, VARIES
6	S15M	STRAIGHT
7	S15M	STRAIGHT
8	S15M	STRAIGHT
9	S15M	250

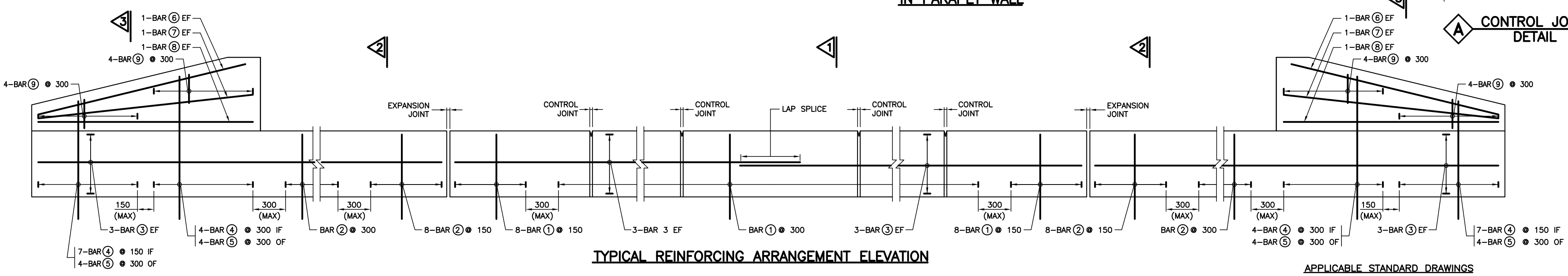
* DIMENSION VARIES FOR DIFFERENT TYPES OF DECKS.

NOTES:

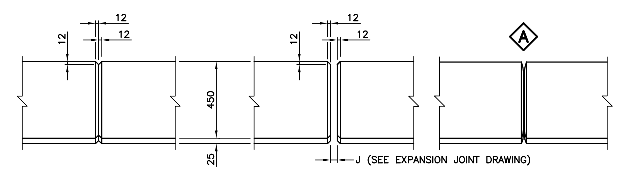
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTH NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



A CONTROL JOINT DETAIL



TYPICAL REINFORCING ARRANGEMENT ELEVATION



TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

APPLICABLE STANDARD DRAWINGS
SS110-96 TWO TUBE RAILING ON PARAPET, TL-5

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

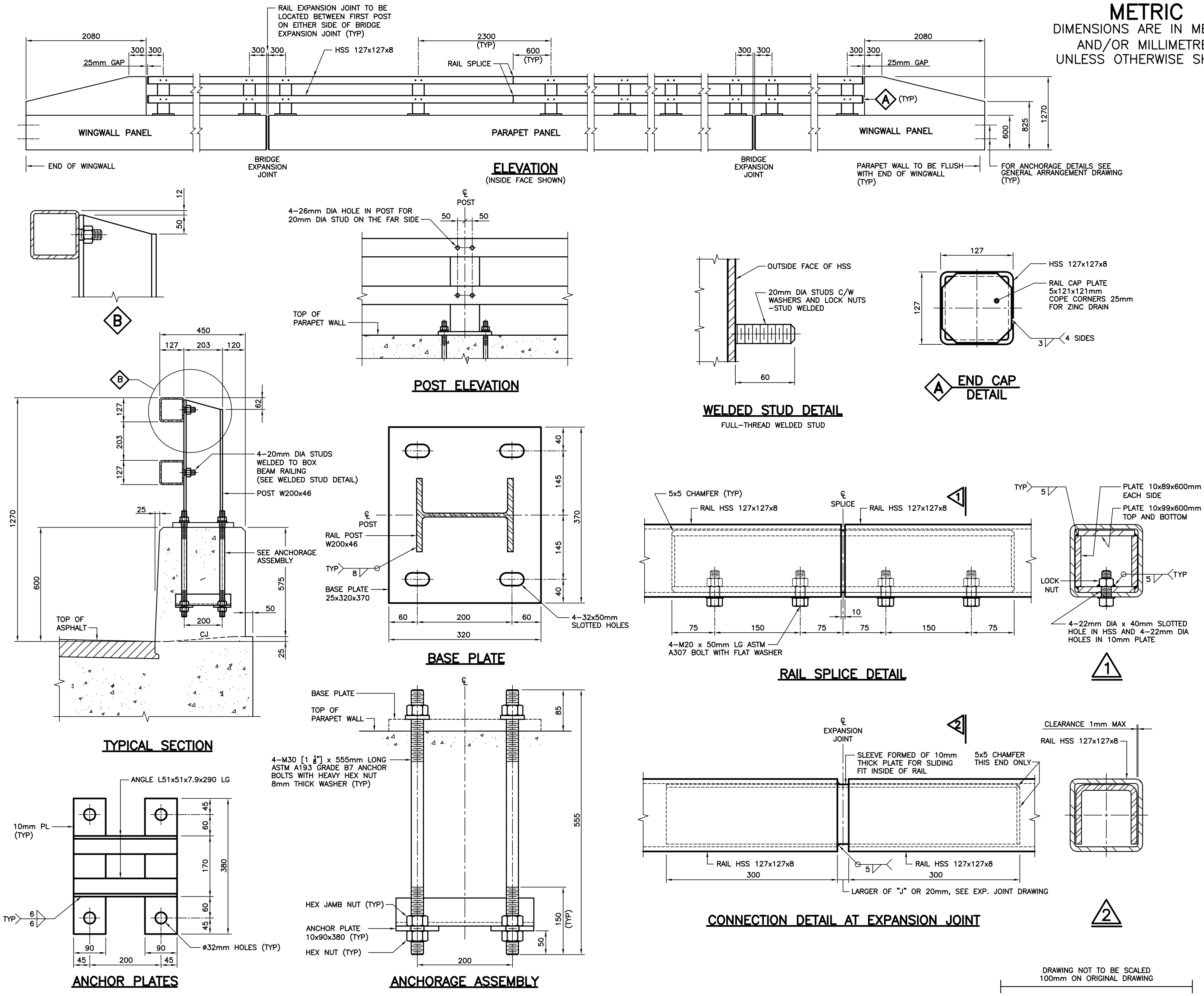
STANDARD DRAWING
SEPTEMBER 2016

SS110-95

PARAPET WALL FOR TWO TUBE RAILING, TL-5 (STAINLESS STEEL REBAR)

REVISIONS | DESCRIPTION

DESIGN | CHK | CODE CHBDC-14 | CL 625-ONT | DATE
DRAWN | CHK | SITE | | DWG



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

TWO TUBE RAILING ON PARAPET – TL-5

NOTES:

1. RAIL ELEMENTS SHALL BE HOLLOW STRUCTURAL SECTIONS GRADE 350WT, CLASS C. RAIL ELEMENT SHALL MEET THE LONGITUDINAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS OF 27 JOULES AT TEST TEMPERATURE OF ____ °C.
   (ASTM A500 GRADE B OR C STEEL MAY BE SUBSTITUTED FOR GRADE 350WT PROVIDED THAT THE CHARPY V-NOTCH IMPACT TEST REQUIREMENTS ARE VERIFIED BY THE SUBMISSION OF TEST DOCUMENTATION).
2. POSTS AND PLATES SHALL BE GRADE 350WT.
3. THE NOTCH TOUGHNESS REQUIREMENTS FOR POSTS AND PLATES SHALL BE THE SAME AS THOSE SPECIFIED IN NOTE 1.
4. ANCHOR STUDS, WASHERS, AND NUTS SHALL BE ACCORDING TO ASTM A193, GRADE B7.
5. FULL THREAD STUDS, WASHERS AND NUTS FOR FASTENING GUIDE RAILS TO POST SHALL BE ACCORDING TO ASTM A108.
6. RAILS SHALL BE SUPPLIED IN LENGTHS TO BE ATTACHED TO A MINIMUM OF THREE (3) RAIL POSTS EXCEPT WHEN THE WINGWALL LENGTH OF A BRIDGE WITH EXPANSION JOINTS DOES NOT PERMIT THIS. IN THIS CASE, THE RAIL LENGTH SHALL BE ATTACHED TO TWO (2) POSTS ON THE WINGWALL.
7. GALVANIZING ON MATING SURFACES OF RAILS TO HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
8. RAILS, POSTS, RAIL SPLICES, AND END CAPS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
9. BOLTS, ANCHOR STUDS, PLATES, WASHERS, AND NUTS SHALL BE HOT-DIP GALVANIZED. LOCK NUTS SHALL BE ZINC PLATED ACCORDING TO ASTM-B695.
10. ALTERNATE RAILS CAPS MAY BE USED WITH APPROVAL OF THE ENGINEER.
11. RAILS SHALL BE PREBENT TO FOLLOW ROAD CURVATURE WHERE RADIUS IS LESS THAN 150 METRES.
12. RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE.
13. RAIL MAY BE CUT AS REQUIRED IN THE FIELD. CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR APPROVED EQUIVALENT.
14. WHEN CONNECTING TO EXISTING RAILING, RAIL MUST BE MADE CONTINUOUS AND POST SPACING DETERMINED WITH REFERENCE TO EXISTING POSTS.
15. GROUT SHALL NOT BE USED UNDER BASE PLATES. THIN PAD OF EPOXY GROUT MAY BE USED WHEN REQUIRED FOR FILLING THE VOIDS UNDER THE BASE PLATE.
16. POST ANCHORING NUTS SHALL BE TIGHTENED TO A SNUG FIT CONDITION AND GIVEN AN ADDITIONAL 1/3 OF A TURN.
17. BOLTS IN RAIL SPLICES SHALL BE TIGHTENED TO A CONDITION THAT WILL ALLOW RAIL MOVEMENT.

NOTES TO DESIGNER:

1. THE IMPACT TEST TEMPERATURE SHALL BE DETERMINED BY REFERRING TO CAN/CSA-S6-14, TABLE 10.13 BASED ON THE MINIMUM SERVICE TEMPERATURE OF THE STRUCTURE GIVEN IN FIGURE A3.1.2.
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

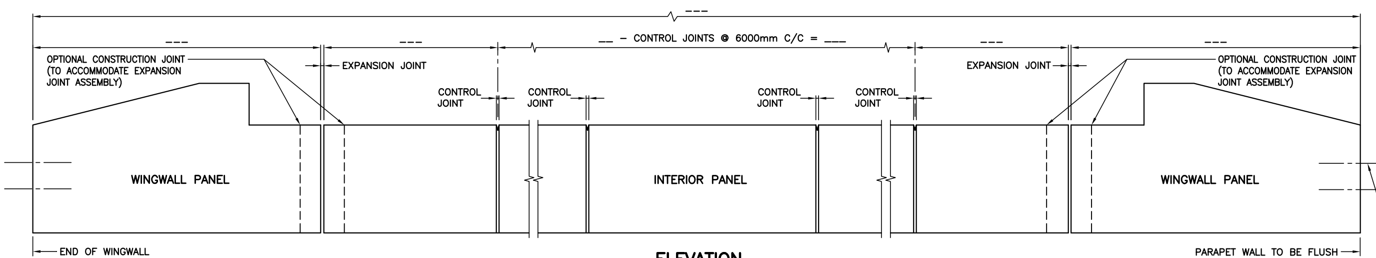
STANDARD DRAWING SEPTEMBER 2016 | SS110-96

TWO TUBE RAILING ON PARAPET – TL-5

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS		DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14 CL 625-ONT	DATE
DRAWN	CHK	SITE	DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

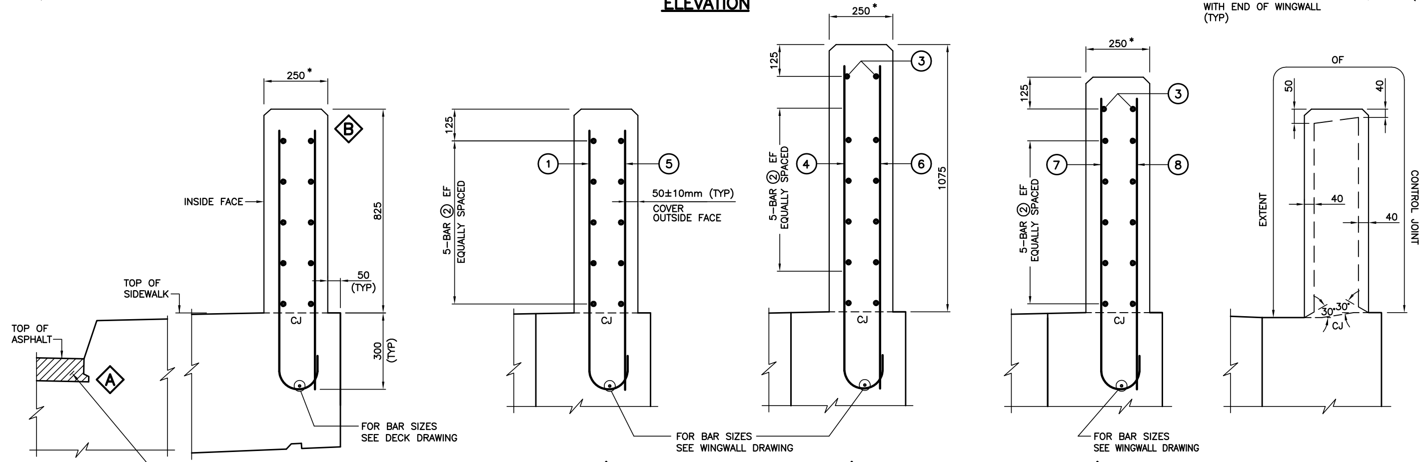


ELEVATION

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

*** NOTE TO DESIGNER:**
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.



1 CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

2 3 CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCING

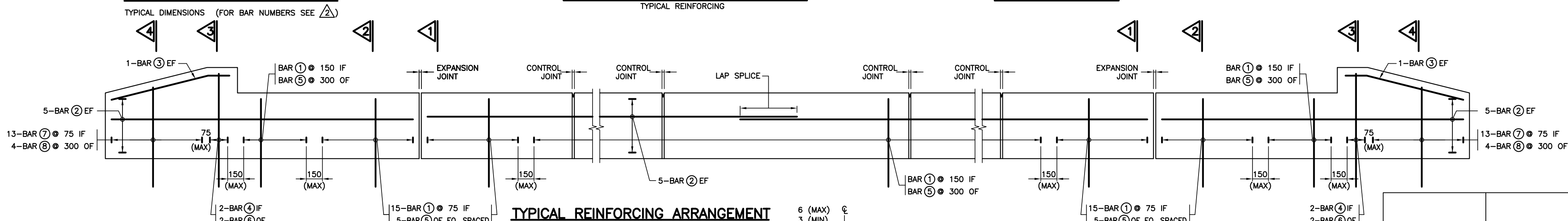
4

EXTENT OF CONTROL JOINT IN PARAPET WALL

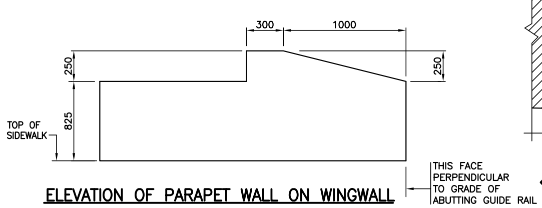
BAR MARK	SIZE	SHAPE
1	GI–20M	190, 80, 950
2	GI–15M	STRAIGHT
3	GI–15M	950, 250
4	GI–20M	190, 80, 1200
5	GI–15M	STRAIGHT
6	GI–15M	STRAIGHT
7	GI–20M	190, 80, VARIES
8	GI–15M	STRAIGHT LENGTH VARIES

NOTES:

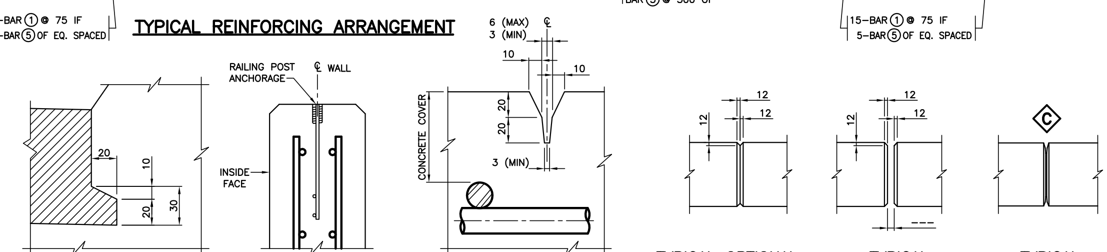
1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE I. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER, AND SHALL HAVE A CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
4. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
5. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
6. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
7. CONTROL JOINT TO BE FORMED.
8. SAWCUTS NOT PERMITTED.
9. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
10. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
11. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
12. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110-98.
13. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



TYPICAL REINFORCING ARRANGEMENT



ELEVATION OF PARAPET WALL ON WINGWALL



A CHASE DETAIL

B POST ANCHORAGE DETAIL

C CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

C TYPICAL CONTROL JOINT

CONT No
WP No

SHEET

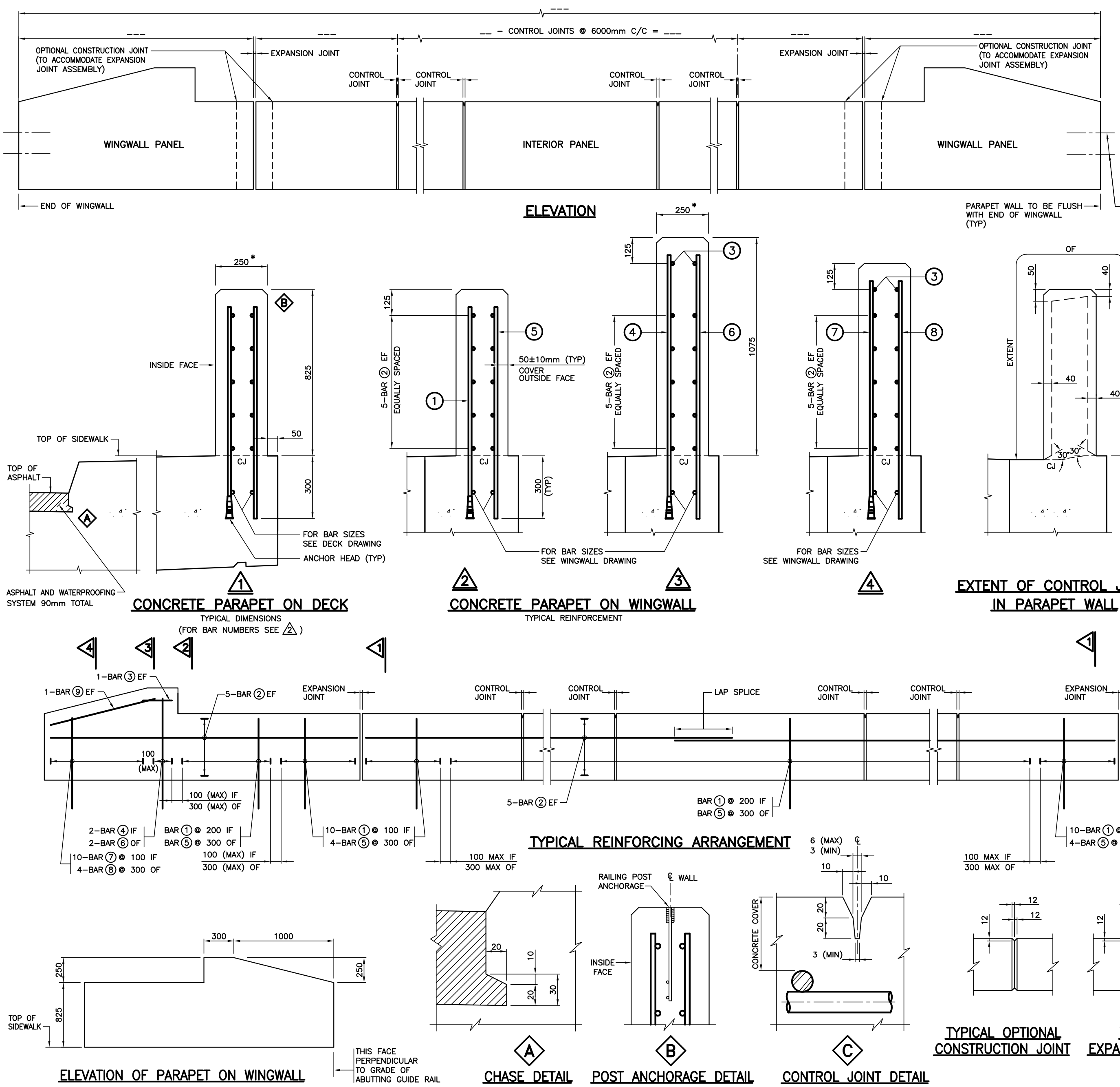
PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (GFRP REBAR)

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:
SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016	SS110-97
PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (GFRP REBAR)	

REVISIONS					DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14	LOAD		DATE	
DRAWN	CHK	SITE			DWG	



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (GFRP REBAR WITH ANCHOR HEAD)

*NOTES TO DESIGNER:

1. INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.
2. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

BAR MARK	SIZE	SHAPE
1	GIII–15M WITH ANCHOR HEAD	STRAIGHT
2	GIII–15M	STRAIGHT
3	GIII–15M	STRAIGHT
4	GIII–15M WITH ANCHOR HEAD	STRAIGHT
5	GIII–13M	STRAIGHT
6	GIII–13M	STRAIGHT
7	GIII–15M WITH ANCHOR HEAD	STRAIGHT, VARIES
8	GIII–13M	STRAIGHT LENGTH VARIES
9	GIII–15M	STRAIGHT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CONCRETE COVER TO REINFORCING BAR 60±10mm EXCEPT AS NOTED.
3. REINFORCING SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE III. SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER AND SHALL HAVE A NOMINAL CROSS SECTIONAL AREA ACCORDING TO CAN/CSA S-807.
4. ANCHOR HEAD OF GFRP REBAR SHALL HAVE A MINIMUM GUARANTEED PULL OUT STRENGTH (Fp) AS FOLLOWS:

SIZE	Fp (kN)
GIII–15M WITH HEAD	100

5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm, UNLESS OTHERWISE SHOWN.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. THIS STANDARD DRAWING MAY BE SUBSTITUTED WITH STANDARD DRAWING SS110-97.
13. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
14. LEGEND: EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

SS110-21 RAILING FOR BARRIER/PARAPET WALL

STANDARD DRAWING SEPTEMBER 2016

SS110-98

PARAPET WALL WITH RAILING ON SIDEWALK TL-4 (GFRP REBAR WITH ANCHOR HEAD)

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

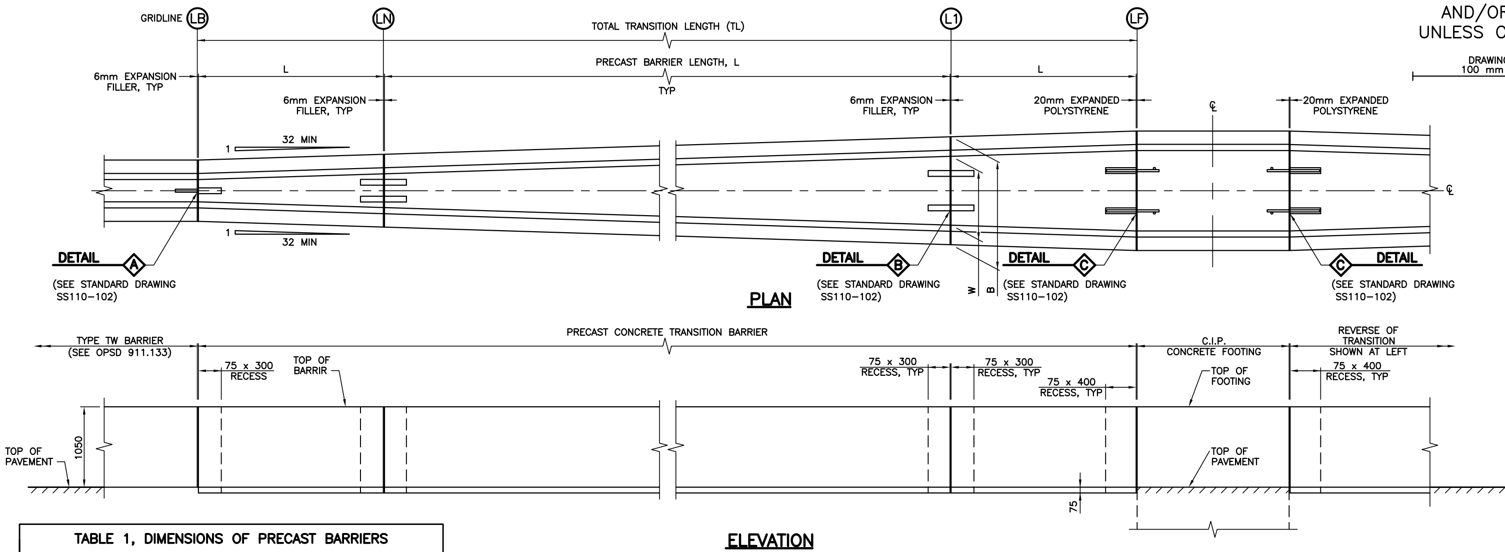
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

CONT No
WP No

PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES–MEDIAN MOUNTED (SYMMETRICAL)

SHEET



NOTES:

1. THE DETAILS OF SIGN SUPPORT OR POLE FOOTING SHALL REFER TO RELEVANT STANDARD DRAWINGS SS118–4 OR SS118–7 OR SS116–51.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING SS110–51.
3. EXPANDED POLYSTYRENE IN EXPANSION JOINT SHALL BE ACCORDING TO CGSB 51.20 AND BE HELD IN PLACE WITH LIGHT GALVANISED NAILS.
4. THE TRANSITION BARRIER SHALL HAVE 75MM EMBEDDMENT.
5. SHOP DRAWINGS SHOWING DETAIL DIMENSIONS OF PRECAST BARRIERS SHALL BE PRODUCED BY THE CONCTRACTOR FOR CA APPROVAL.

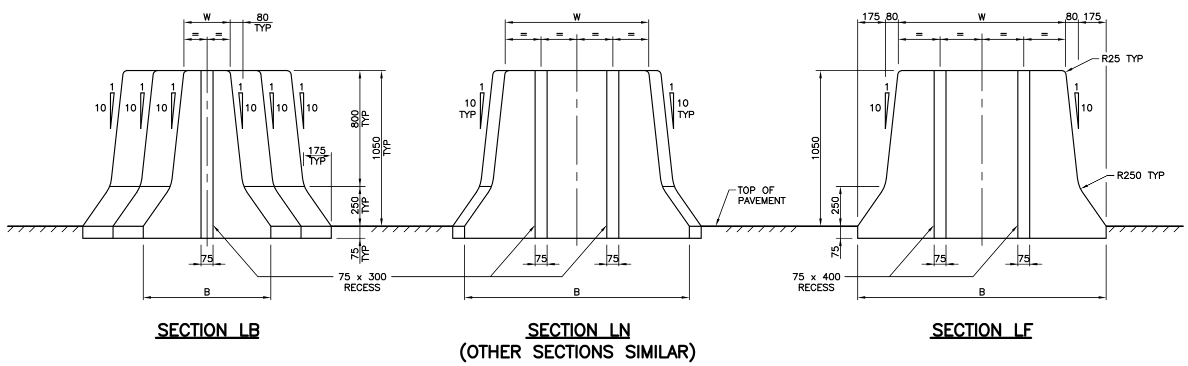
NOTES TO DESIGNER:

1. DIMENSIONS OF PRECAST CONCRETE BARRIERS CAN BE TAKEN FROM THE DESIGN INFORMATION TABLE ACCORDING TO THE TYPE OF STRUCTURE.
2. THE "DESIGN INFORMATION TABLE" AND "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

TABLE 1, DIMENSIONS OF PRECAST BARRIERS

STATION	STRUCTURE TYPE	N	TL	L	SECTION	W	B
---	---	---	---	---	LF	---	---
					L1	---	---
					L2	---	---
					L3	---	---
					L4	---	---
					L5	---	---
					L6	---	---
					L7	---	---
					L8	---	---
					LB	---	---
---	---	---	---	---	LF	---	---
					L1	---	---
					L2	---	---
					L3	---	---
					L4	---	---
					L5	---	---
					L6	---	---
					L7	---	---
					L8	---	---
					LB	---	---
---	---	---	---	---	LF	---	---
					L1	---	---
					L2	---	---
					L3	---	---
					L4	---	---
					L5	---	---
					L6	---	---
					L7	---	---
					L8	---	---
					LB	---	---

N = NO. OF PRECAST BARRIER
TL = TOTAL TRANSITION LENGTH
L = PRECAST BARRIER LENGTH
W = WIDTH AT TOP OF PRECAST BARRIER
B = WIDTH AT BASE OF PRECAST BARRIER
RIGHT SIDE PRECAST BARRIERS SIMILAR



DESIGN INFORMATION TABLE

STRUCTURE TYPE	N	TL	L	LB W	LB B	L8 W	L8 B	L7 W	L7 B	L6 W	L6 B	L5 W	L5 B	L4 W	L4 B	L3 W	L3 B	L2 W	L2 B	L1 W	L1 B	LF W	LF B
STATIC SIGN	5	12150	2420	290	800									445	955	595	1105	745	1255	900	1410	1050	1560
VMS	3	7298	2420	290	800													440	950	590	1100	740	1250
HIGH MAST (25m)	7	17002	2420	290	800					445	955	595	1105	745	1255	895	1405	1050	1560	1200	1710	1350	1860
HIGH MAST (30, 35m)	8	19428	2420	290	800			445	955	595	1105	745	1255	895	1405	1050	1560	1200	1710	1350	1860	1500	2010
HIGH MAST (40, 40m)	9	21854	2420	290	800	445	955	595	1105	745	1255	895	1405	1050	1560	1200	1710	1350	1860	1500	2010	1650	2160

(BARRIER DIMENSIONS AT GRIDLINE)

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING JAN 2012

SS110–100

PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES MEDIAN MOUNTED (SYMMETRICAL)

REVISIONS	DESCRIPTION			
DESIGN	CHK	CODE CHBDC–06	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH–D–707 88–05

METRIC

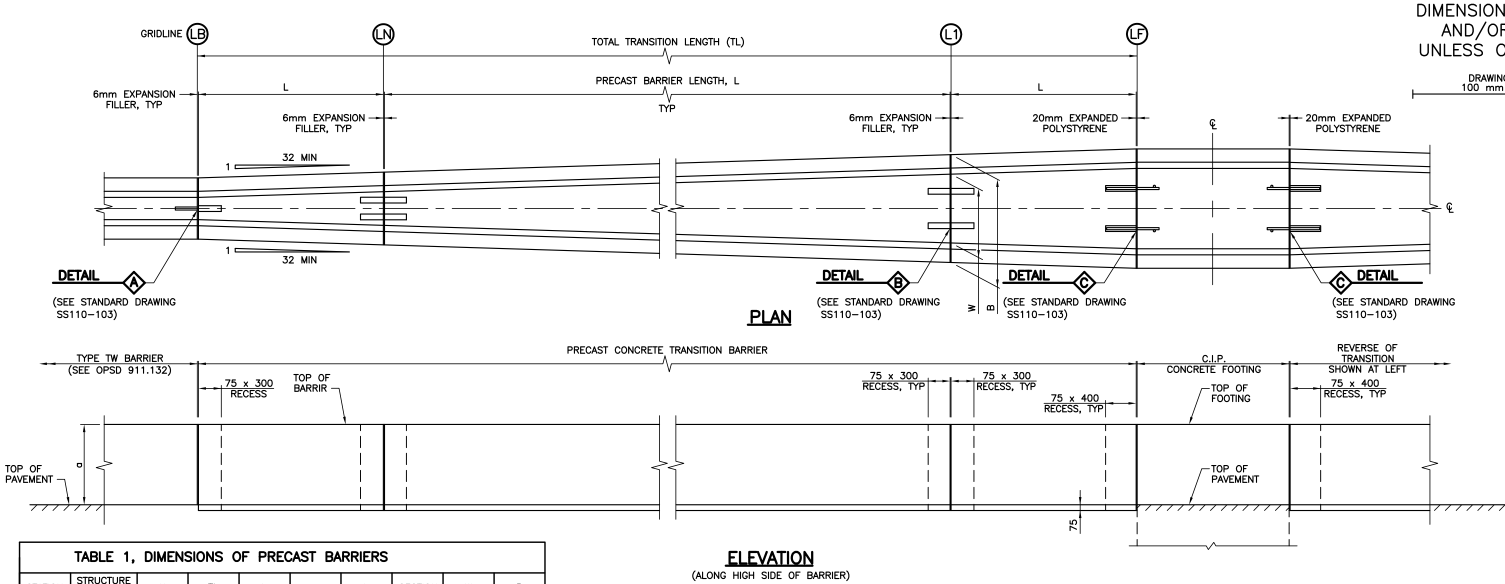
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

CONT No
WP No

PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES–MEDIAN MOUNTED (ASYMMETRICAL)

SHEET



NOTES:

1. THE DETAILS OF SIGN SUPPORT OR POLE FOOTING SHALL REFER TO RELEVANT STANDARD DRAWINGS SS118–5 OR SS118–8 OR SS116–52.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING SS110–94.
3. EXPANDED POLYSTYRENE IN EXPANSION JOINT SHALL BE ACCORDING TO OPSS 920 AND BE HELD IN PLACE WITH LIGHT GALVANISED NAILS.
4. THE TRANSITION BARRIER SHALL HAVE 75MM EMBEDDMENT.
5. SHOP DRAWINGS SHOWING DETAIL DIMENSIONS OF PRECAST BARRIERS SHALL BE PRODUCED BY THE CONCTRACTOR FOR CA APPROVAL.

NOTES TO DESIGNER:

1. FOR b=140mm, DIMENSIONS OF PRECAST CONCRETE BARRIERS CAN BE TAKEN FROM THE DESIGN INFORMATION TABLE ACCORDING TO THE TYPE OF STRUCTURE. FOR OTHER VALUES OF 'b', DIMENSIONS 'W' AND 'B' AT GRIDLINE 'LN' CAN BE RE–CALCULATED USING THE FOLOWING EQUATIONS:

$$b=\frac{a-250}{10} \qquad W_{LN}=W_{LF}-\frac{N(W_{LF}-W_{LB})L}{TL} \qquad B_{LN}=b+430+W_{LN}$$

NOTES:

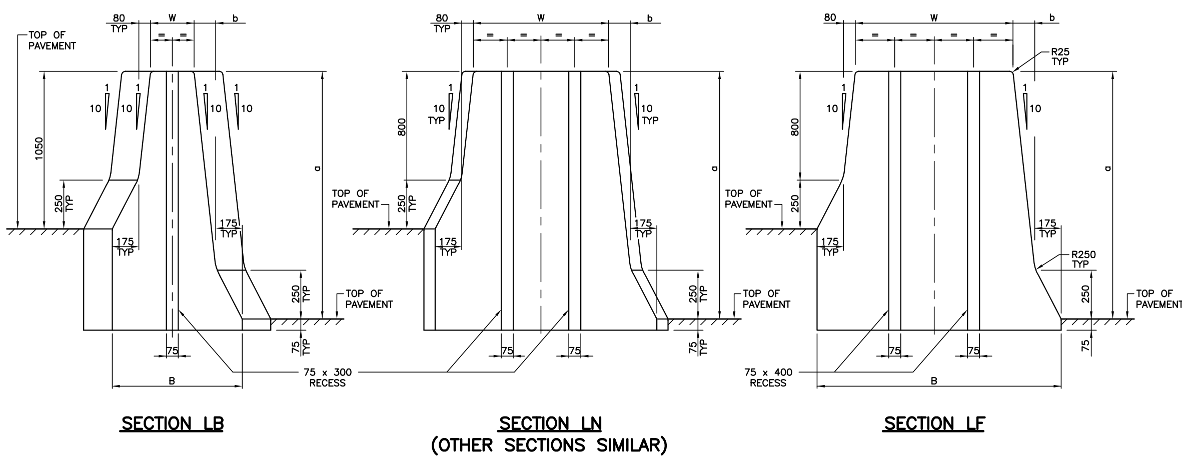
1) W_{LF} AND W_{LB} ARE WIDTH 'W' AT GRIDLINES 'LF' AND 'LB' RESPECTIVELY.
2) W_{LN} IS WIDTH AT GRIDLINE 'LN'.
3) N=1, 2, 3 ETC. FOR GRIDLINE 'L1', 'L2', AND 'L3' ACCORDINGLY.
4) VALUES OF 'B' SHALL BE ROUND OFF TO THE NEAREST 5mm.

2. THE "DESIGN INFORMATION TABLE" AND "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

TABLE 1, DIMENSIONS OF PRECAST BARRIERS

STATION	STRUCTURE TYPE	N	TL	L	a	b	SECTION	W	B
---	---	---	---	---	---	---	LF	---	---
							L1	---	---
							L2	---	---
							L3	---	---
							L4	---	---
							L5	---	---
							L6	---	---
							L7	---	---
							L8	---	---
							LB	---	---
---	---	---	---	---	---	---	LF	---	---
							L1	---	---
							L2	---	---
							L3	---	---
							L4	---	---
							L5	---	---
							L6	---	---
							L7	---	---
							L8	---	---
							LB	---	---
---	---	---	---	---	---	---	LF	---	---
							L1	---	---
							L2	---	---
							L3	---	---
							L4	---	---
							L5	---	---
							L6	---	---
							L7	---	---
							L8	---	---
							LB	---	---

N = NO. OF PRECAST BARRIER
TL = TOTAL TRANSITION LENGTH
L = PRECAST BARRIER LENGTH
W = WIDTH AT TOP OF PRECAST BARRIER
B = WIDTH AT BASE OF PRECAST BARRIER
RIGHT SIDE PRECAST BARRIERS SIMILAR



REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DESIGN INFORMATION TABLE				BARRIER DIMENSIONS AT GRIDLINE																			
				LB		L8		L7		L6		L5		L4		L3		L2		L1		LF	
STRUCTURE TYPE	N	TL	L	W	B	W	B	W	B	W	B	W	B	W	B	W	B	W	B	W	B	W	B
STATIC SIGN	5	12150	2420	290	860	---	---	---	---	---	---	---	---	445	1015	595	1165	745	1315	900	1470	1050	1620
VMS	3	7298	2420	290	860	---	---	---	---	---	---	---	---	---	---	---	---	440	1010	590	1160	740	1310
HIGH MAST (25m)	7	17002	2420	290	860	---	---	---	---	445	1015	595	1165	745	1315	895	1465	1050	1620	1200	1770	1350	1920
HIGH MAST (30, 35m)	8	19428	2420	290	860	---	---	445	1015	595	1165	745	1315	895	1465	1050	1620	1200	1770	1350	1920	1500	2070
HIGH MAST (40, 45m)	9	21854	2420	290	860	445	1015	595	1165	745	1315	895	1465	1050	1620	1200	1770	1350	1920	1500	2070	1650	2220

STANDARD DRAWING JAN 2012

SS110–101

PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES MEDIAN MOUNTED (ASYMMETRICAL)

REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE CHBDC–06	LOAD		DATE
DRAWN	CHK	SITE			DWG

METRIC

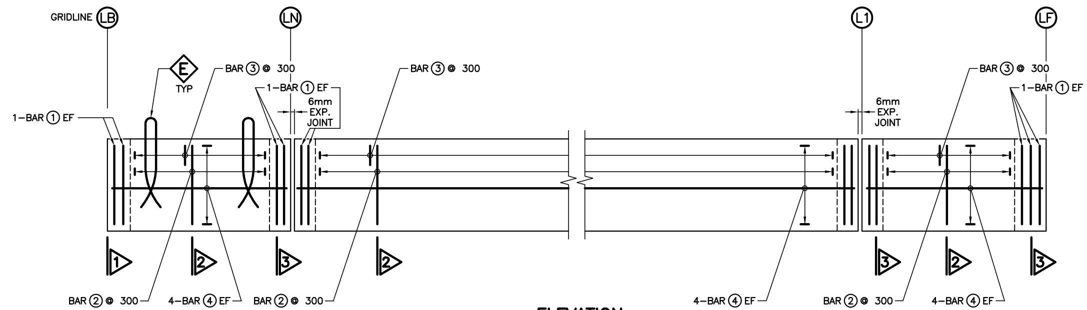
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

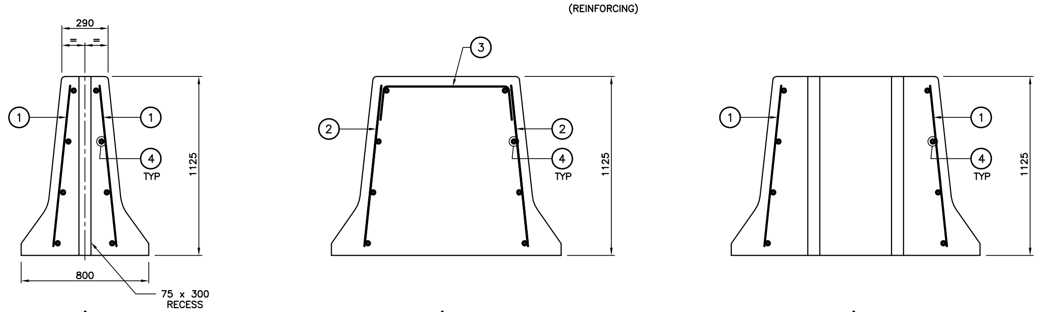
CONT No
WP No

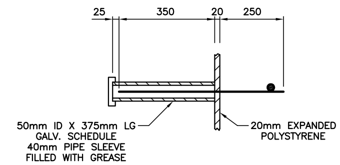
SHEET

PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES – REINFORCING AND CONNECTION DETAILS (SYMMETRICAL)

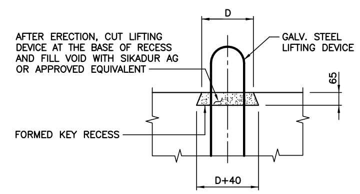


ELEVATION
(REINFORCING)

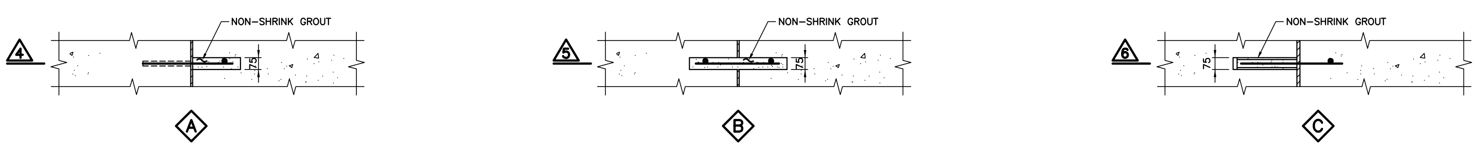




DETAIL D



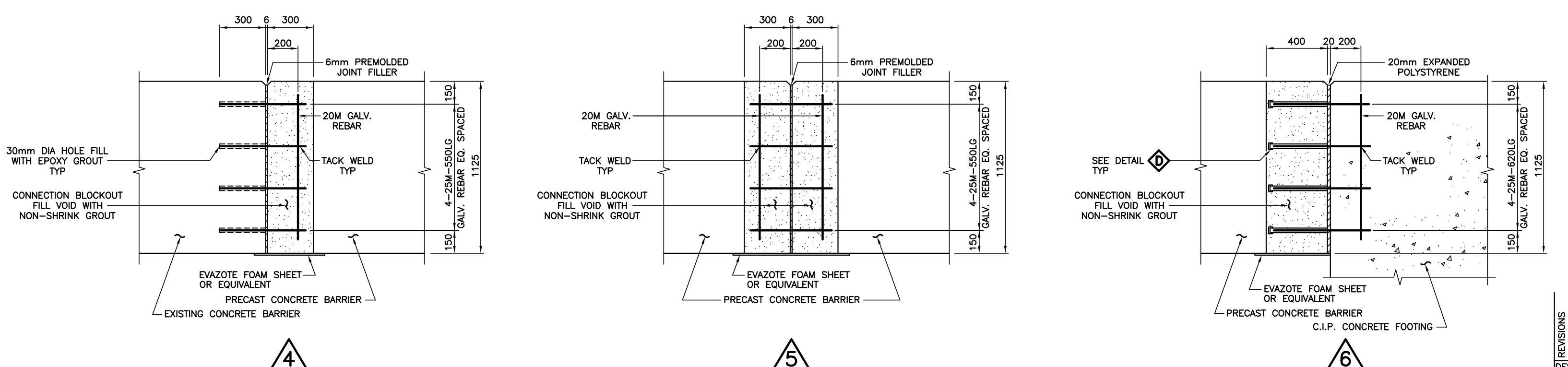
E
STEEL LIFTING DEVICE



CONNECTION ASSEMBLY TO EXISTING BARRIER

TYPICAL CONNECTION ASSEMBLY

CONNECTION ASSEMBLY TO C.I.P. CONCRETE FOOTING



NOTES:

1. CLEAR COVER TO REINFORCING STEEL SHALL BE 70±20mm EXCEPT AS NOTED.
2. CLASS OF CONCRETE 30MPa.
3. REINFORCEMENT SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE III (GIII). SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER.
4. REBARS IN THE CONNECTION BLOCKOUT SHALL BE GRADE 400W AND HOT–DIP GALVANISED AFTER FABRICATION.
5. LAYOUT OF REINFORCEMENT WILL BE SIMILAR FOR RIGHT HAND TRANSITION BARRIERS.
6. ALL CONCRETE EDGES TO HAVE 15mm X 45° CHAMFER EXCEPT AS NOTED.
7. THE REBARS IN THE CONNECTION BLOCKOUT SHOULD BE CENTRED BEFORE ADDING GROUT.
8. WELDING SHALL BE ACCORDING TO CAN/CSA–W59–03.
9. ALL LIFTING INSERTS SHALL BE RECESSED AND GALVANISED.
10. ALL CUT LIFTING INSERTS SHALL BE TREATED WITH GALVA–GUARD OR APPROVED EQUIVALENT PRIOR TO PARGING AND SHALL BE PARGED AFTER ERECTION WITH SIKADUR AG GROUT OR APPROVED EQUIVALENT.
11. DETAILS AND LOCATIONS OF LIFTING DEVICE SHALL BE DESIGNED BY THE CONTRACTOR.
12. FOR DIMENSIONS OF PRECAST BARRIERS SEE SS110–100.

BAR MARK	SIZE	SHAPE
1	GIII–15M	STRAIGHT
2	GIII–15M	STRAIGHT
3	GIII–15M	VARIES 180
4	GIII–15M	STRAIGHT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING JULY 2014

SS110–102

PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES – REINFORCING AND CONNECTION DETAILS (SYMMETRICAL)

REVISIONS			
DESCRIPTION			
DESIGN	CHK	CODE CHBDC–06	LOAD	DATE
DRAWN	CHK	SITE		DWG

METRIC

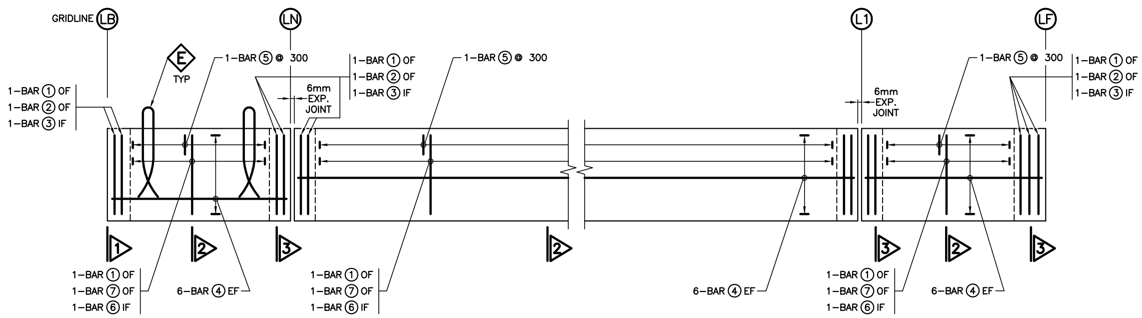
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

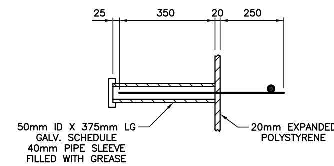
CONT No
WP No

SHEET

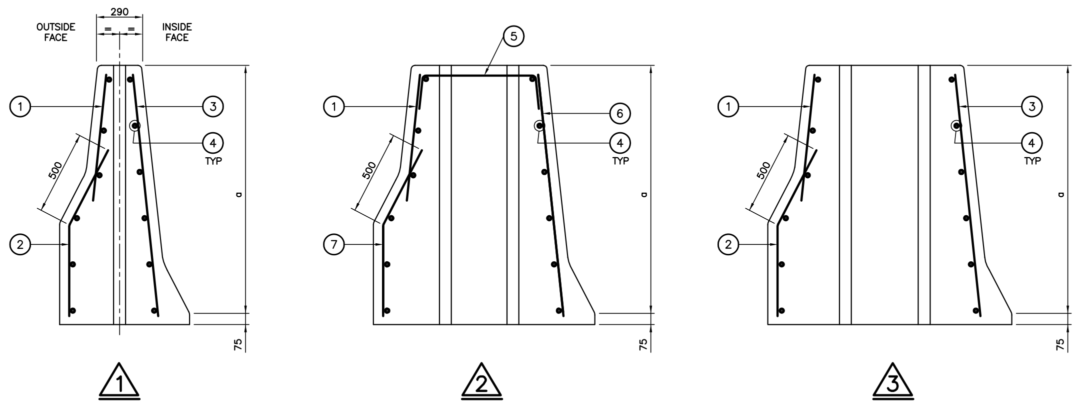
PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES – REINFORCING AND CONNECTION DETAILS (ASYMMETRICAL)

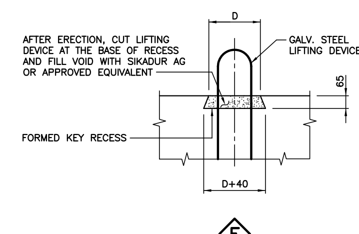


ELEVATION
(REINFORCING)

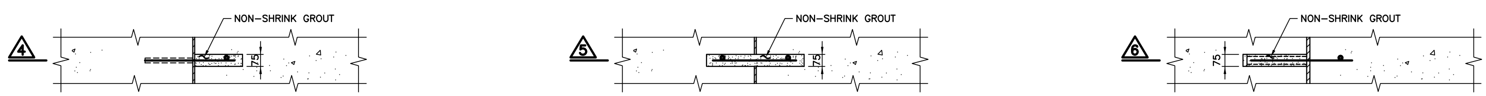


DETAIL D





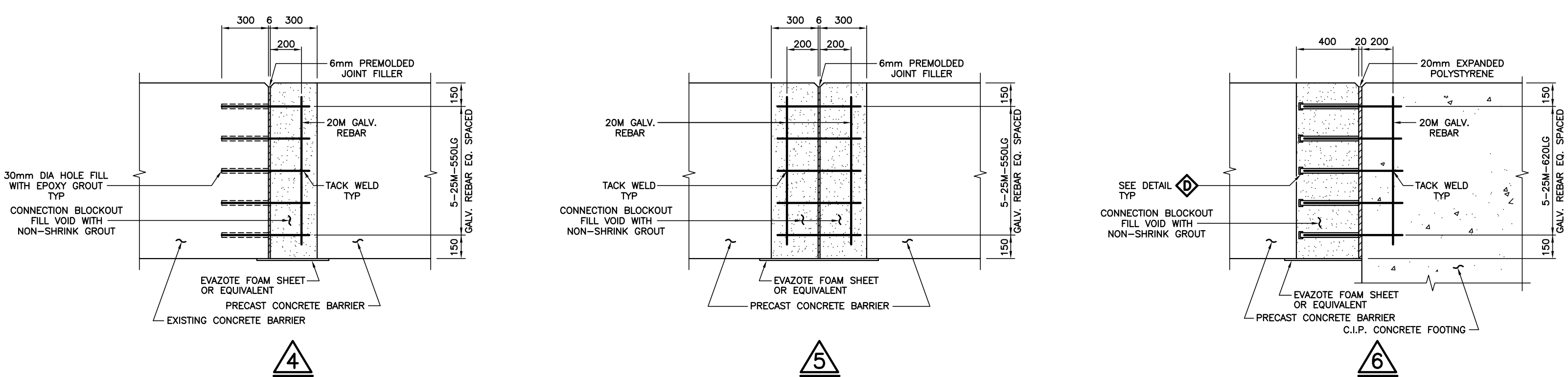
E STEEL LIFTING DEVICE



A CONNECTION ASSEMBLY TO EXISTING BARRIER

B TYPICAL CONNECTION ASSEMBLY

C CONNECTION ASSEMBLY TO C.I.P. CONCRETE FOOTING



NOTES:

1. CLEAR COVER TO REINFORCING STEEL SHALL BE 70±20mm EXCEPT AS NOTED.
2. CLASS OF CONCRETE 30MPa.
3. REINFORCEMENT SHALL BE GLASS FIBRE REINFORCED POLYMER (GFRP) GRADE III (GIII). SIZE IN THE BAR SCHEDULE INDICATES GFRP GRADE AND DESIGNATED BAR DIAMETER.
4. REBARS IN THE CONNECTION BLOCKOUT SHALL BE GRADE 400W AND HOT–DIP GALVANISED AFTER FABRICATION.
5. LAYOUT OF REINFORCEMENT WILL BE SIMILAR FOR RIGHT HAND TRANSITION BARRIERS.
6. ALL CONCRETE EDGES TO HAVE 15mm X 45° CHAMFER EXCEPT AS NOTED.
7. THE REBARS IN THE CONNECTION BLOCKOUT SHOULD BE CENTRED BEFORE ADDING GROUT.
8. WELDING SHALL BE ACCORDING TO CAN/CSA–W59–03.
9. ALL LIFTING INSERTS SHALL BE RECESSED AND GALVANISED.
10. ALL CUT LIFTING INSERTS SHALL BE TREATED WITH GALVA–GUARD OR APPROVED EQUIVALENT PRIOR TO PARGING AND SHALL BE PARGED AFTER ERECTION WITH SIKADUR AG GROUT OR APPROVED EQUIVALENT.
DETAILS AND LOCATIONS OF LIFTING DEVICE SHALL BE
11. DESIGNED BY THE CONTRACTOR.
12. FOR DIMENSIONS OF PRECAST BARRIERS SEE SS110–101.

BAR MARK	SIZE	SHAPE
①	GIII–15M	STRAIGHT
②	GIII–15M	500
③	GIII–15M	STRAIGHT
④	GIII–15M	STRAIGHT
⑤	GIII–15M	VARIES 180
⑥	GIII–15M	STRAIGHT
⑦	GIII–15M	500

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING JULY 2014

SS110–103

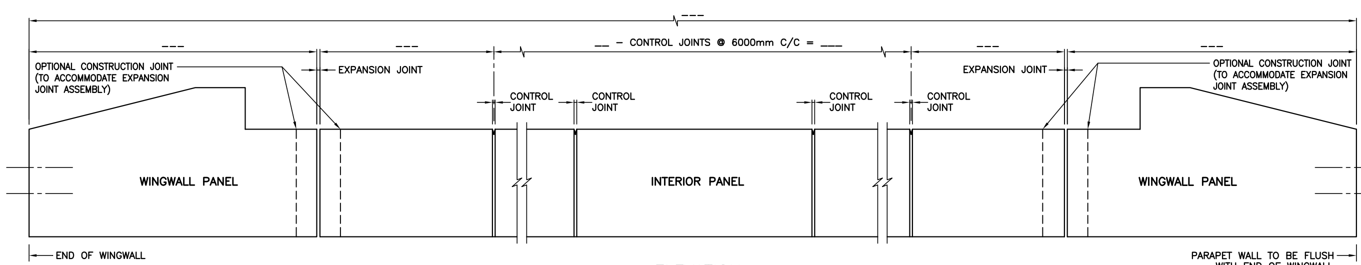
PRECAST TRANSITION CONCRETE BARRIER AT SIGN SUPPORTS AND POLES – REINFORCING AND CONNECTION DETAILS (ASYMMETRICAL)

REVISIONS

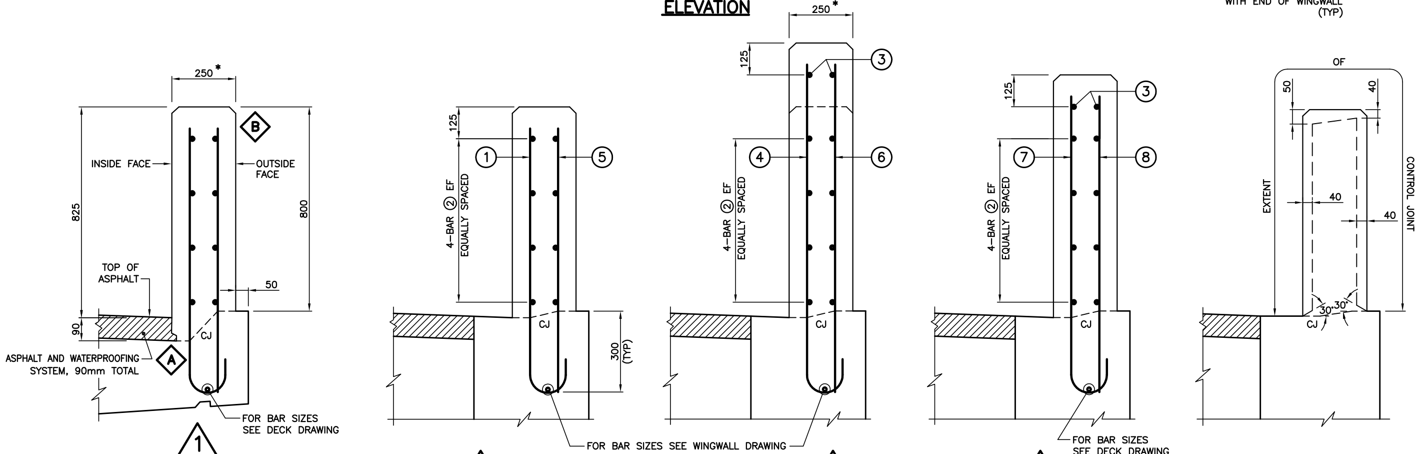
DESCRIPTION

DESIGN	CHK	CODE CHBDC–06	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH–D–707 88–05



ELEVATION



1 CONCRETE PARAPET ON DECK

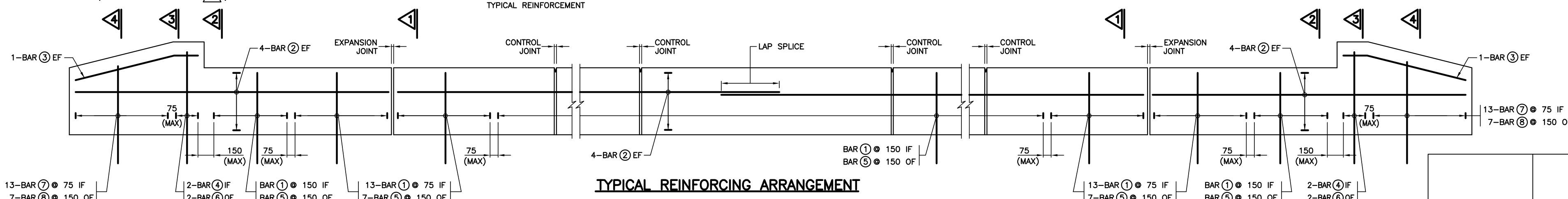
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

2 CONCRETE PARAPET ON WINGWALL 3

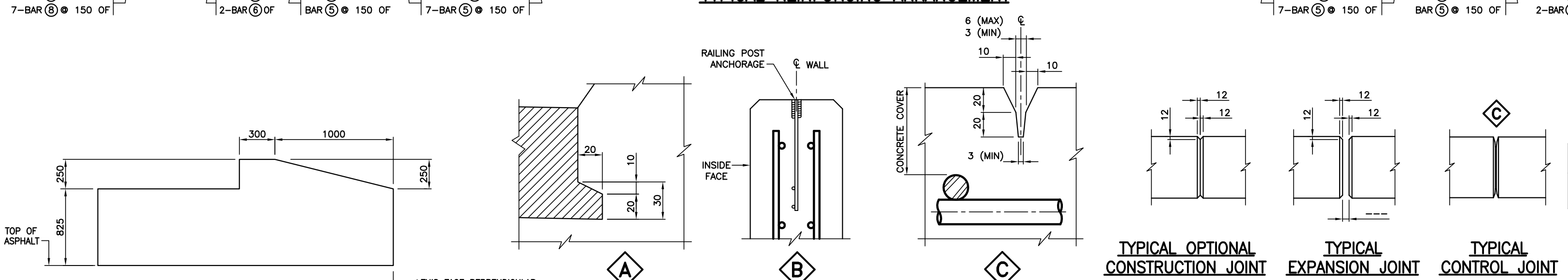
TYPICAL REINFORCEMENT

4

EXTENT OF CONTROL JOINT IN PARAPET WALL



TYPICAL REINFORCING ARRANGEMENT



ELEVATION OF PARAPET ON WINGWALL

A CHASE DETAIL

B POST ANCHORAGE DETAIL

C CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

C TYPICAL CONTROL JOINT

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

CONT No
WP No

SHEET

PARAPET WALL WITH RAILING, TL–4 (BLACK STEEL REBAR)

* NOTE TO DESIGNER
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.

BAR MARK	SIZE	SHAPE
1	15M	130, 65
2	15M	STRAIGHT
3	15M	225, 985, 240
4	15M	130, 65
5	10M	STRAIGHT
6	10M	STRAIGHT
7	15M	130, 65, VARIES
8	10M	STRAIGHT, LENGTH VARIES

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING IS ONLY APPLICABLE IN BRIDGE REHABILITATION WHEN THE REMAINING LIFE OF THE BRIDGE IS LESS THAN 35 YEARS.
3. CONCRETE COVER TO REINFORCING STEEL 70 ±20mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE GRADE 400W.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND:
    - EF – DENOTES EACH FACE
    - IF – DENOTES INSIDE FACE
    - OF – DENOTES OUTSIDE FACE
    - CJ – CONSTUCTION JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS:
SS110–21 RAILING FOR BARRIER/PARAPET WALL

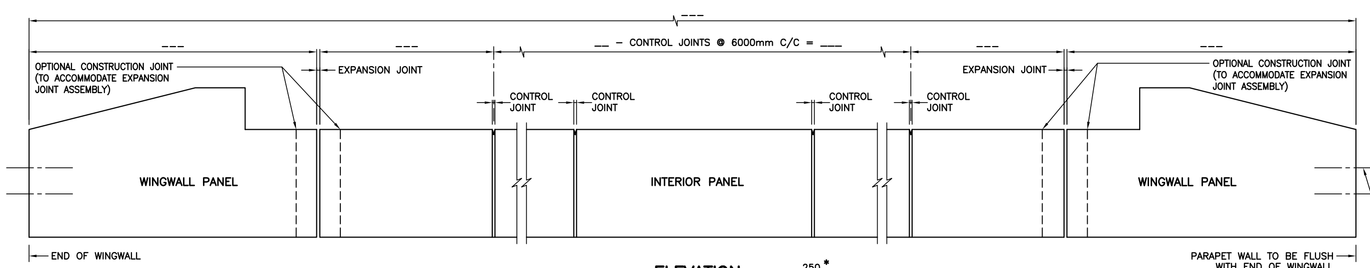
STANDARD DRAWING SEPTEMBER 2016 | SS110–104

PARAPET WALL WITH RAILING, TL–4 (BLACK STEEL REBAR)

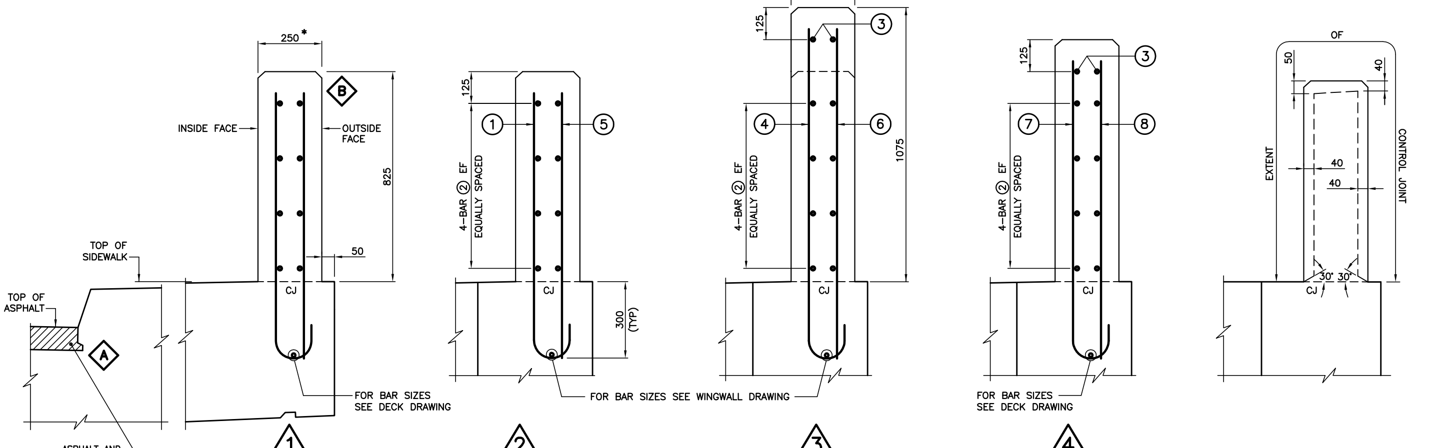
REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05



ELEVATION



1 CONCRETE PARAPET ON DECK

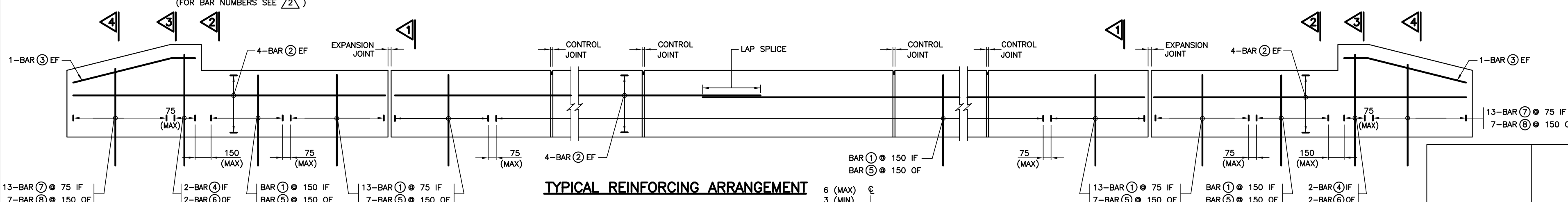
TYPICAL DIMENSIONS (FOR BAR NUMBERS SEE 2)

2 CONCRETE PARAPET ON WINGWALL 3

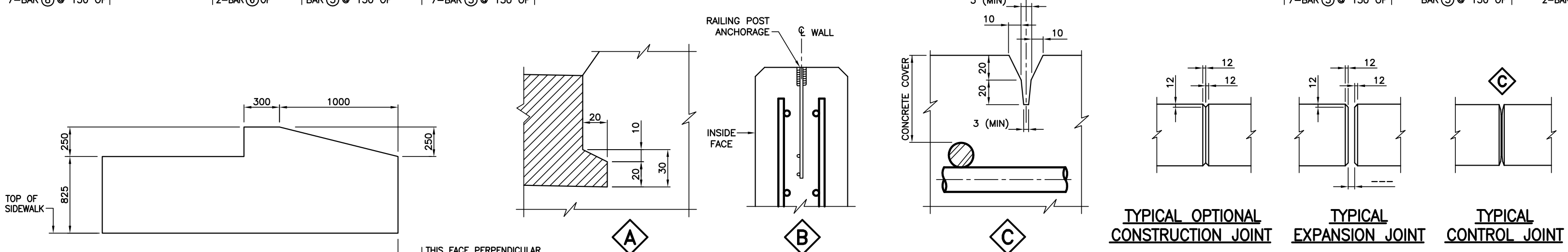
TYPICAL REINFORCEMENT

4

EXTENT OF CONTROL JOINT IN PARAPET WALL



TYPICAL REINFORCING ARRANGEMENT



ELEVATION OF PARAPET ON WINGWALL

A CHASE DETAIL

B POST ANCHORAGE DETAIL

C CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

*** NOTE TO DESIGNER**

INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.

BAR MARK	SIZE	SHAPE
1	15M	130, 65
2	15M	STRAIGHT
3	15M	225, 985, 240
4	15M	130, 65
5	10M	STRAIGHT
6	10M	STRAIGHT
7	15M	130, 65, VARIES
8	10M	STRAIGHT, LENGTH VARIES

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING IS ONLY APPLICABLE IN BRIDGE REHABILITATION WHEN THE REMAINING LIFE OF THE BRIDGE IS LESS THAN 35 YEARS.
3. CONCRETE COVER TO REINFORCING STEEL 70 ±20mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE GRADE 400W.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND:
    - EF – DENOTES EACH FACE
    - IF – DENOTES INSIDE FACE
    - OF – DENOTES OUTSIDE FACE
    - CJ – CONSTRUCTION JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

SS110-21 RAILING FOR BARRIER/PARAPET WALL

CONT No
WP No

SHEET

PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (BLACK STEEL REBAR)

STANDARD DRAWING SEPTEMBER 2016 — SS110-105

PARAPET WALL WITH RAILING ON SIDEWALK, TL-4 (BLACK STEEL REBAR)

REVISIONS — DESCRIPTION

DESIGN	CHK	CODE CHBDC-14	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

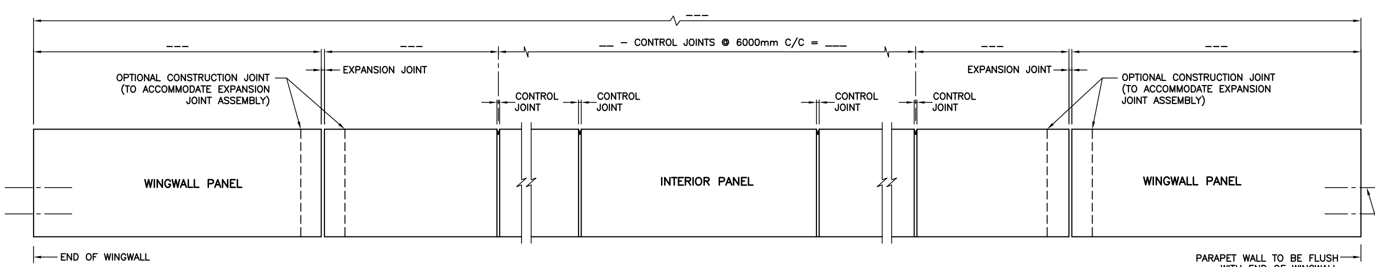
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONT No
WP No

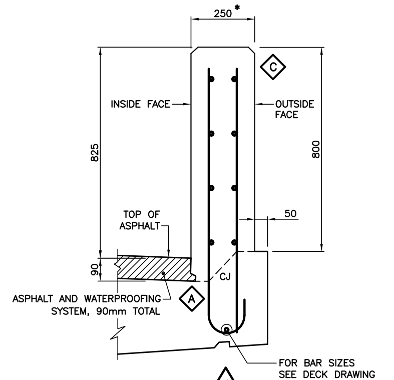
SHEET

PARAPET WALL WITHOUT RAILING, TL-4
(BLACK STEEL REBAR)

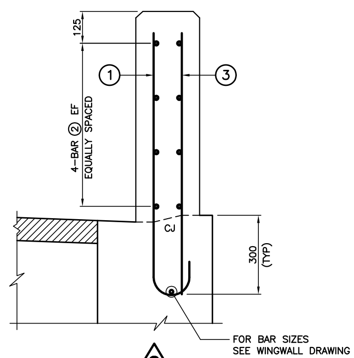
*** NOTE TO DESIGNER**
INCREASE THE THICKNESS OF THE WALL FROM 250 TO 300mm WHEN 75mm DIA. ELECTRICAL DUCTS ARE REQUIRED.



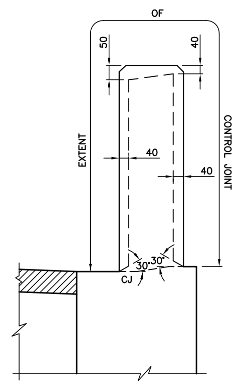
ELEVATION



1
CONCRETE PARAPET ON DECK
TYPICAL DIMENSIONS
(FOR BAR NUMBERS SEE 2)



2
CONCRETE PARAPET ON WINGWALL
TYPICAL REINFORCEMENT

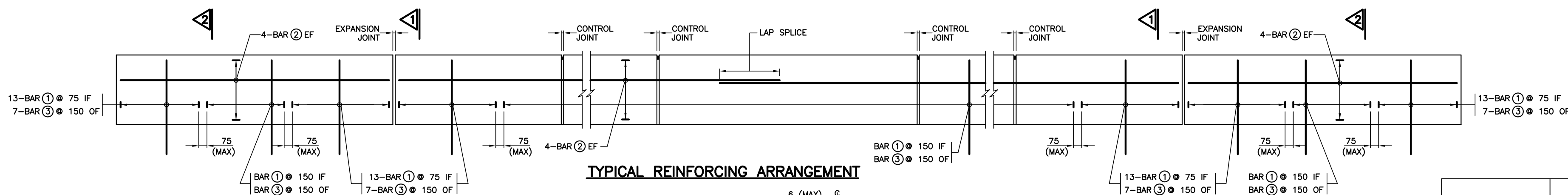


EXTENT OF CONTROL JOINT IN PARAPET WALL

BAR MARK	SIZE	SHAPE
1	15M	130, 65 (hooked)
2	15M	STRAIGHT
3	10M	STRAIGHT

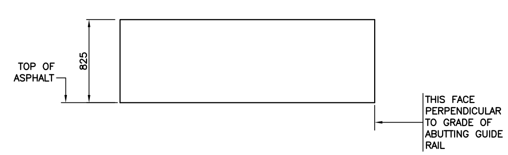
NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING IS ONLY APPLICABLE IN BRIDGE REHABILITATION WHEN THE REMAINING LIFE OF THE BRIDGE IS LESS THAN 35 YEARS.
3. CONCRETE COVER TO REINFORCING STEEL 70 ±20mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE GRADE 400W.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND:
    EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT

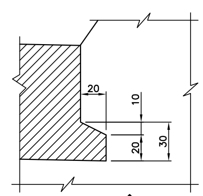


TYPICAL REINFORCING ARRANGEMENT

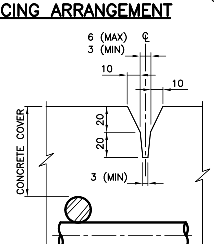
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.



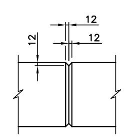
ELEVATION OF PARAPET ON WINGWALL



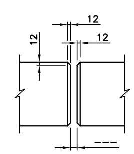
A
CHASE DETAIL



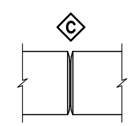
C
CONTROL JOINT DETAIL



TYPICAL OPTIONAL CONSTRUCTION JOINT



TYPICAL EXPANSION JOINT



TYPICAL CONTROL JOINT

STANDARD DRAWING
SEPTEMBER 2016

SS110–106

PARAPET WALL WITHOUT RAILING, TL–4
(BLACK STEEL REBAR)

REVISIONS	DESCRIPTION			
DESIGN	CHK	CODE CHBDC–14	LOAD	DATE
DRAWN	CHK	SITE		DWG

METRIC

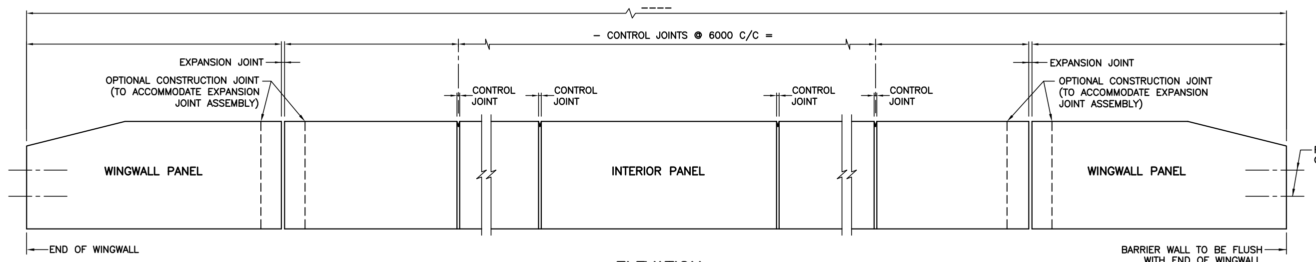
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

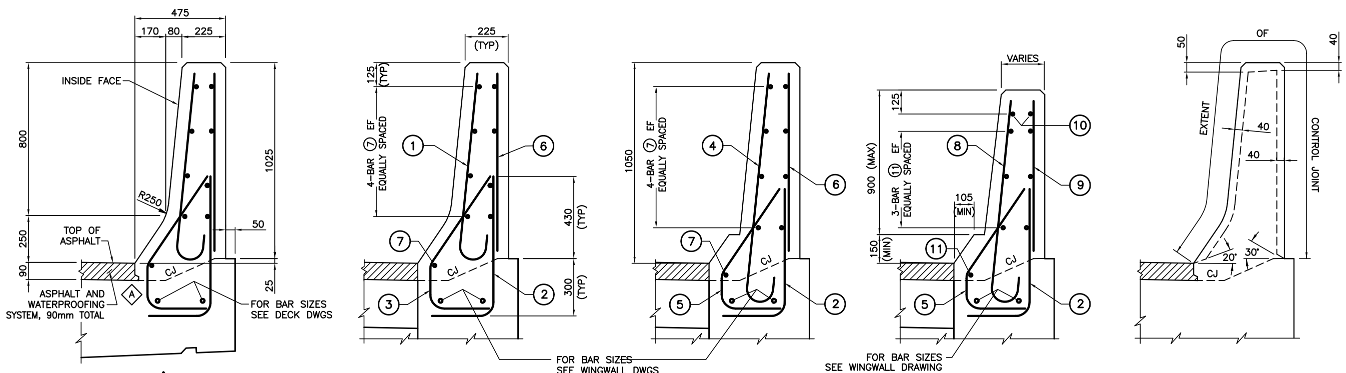
CONT No
WP No

SHEET

BARRIER WALL WITHOUT RAILING, TL-5 (BLACK STEEL REBAR)



ELEVATION



BARRIER WALL ON DECK
TYPICAL DIMENSIONS
(FOR BAR NUMBERS SEE 2)

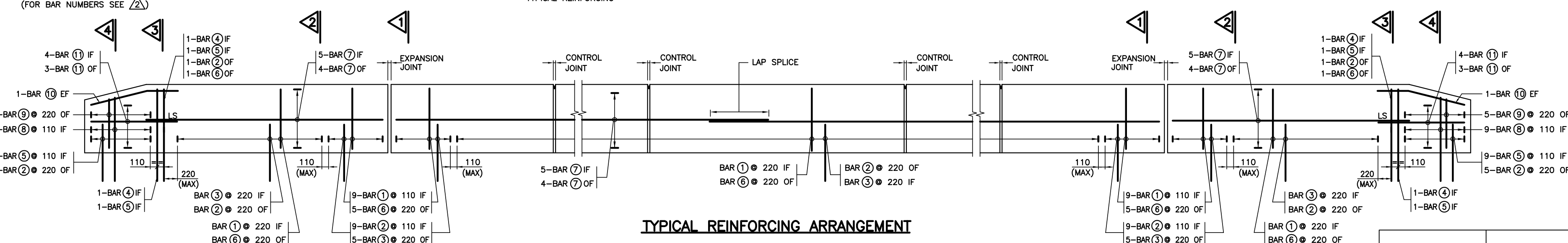
BARRIER WALL ON WINGWALL
TYPICAL REINFORCING

EXTENT OF CONTROL JOINT IN BARRIER WALL

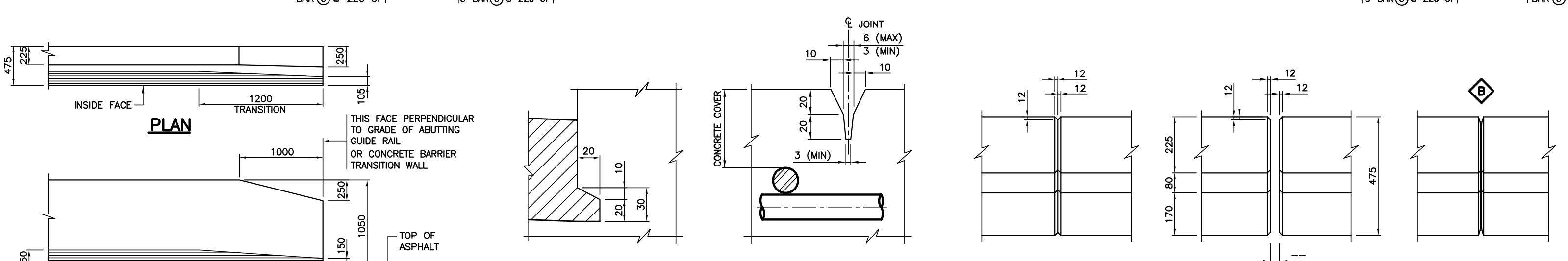
BAR MARK	SIZE	SHAPE
1	15M	130, 65
2	10M	300, 740
3	15M	300, 205, 540, 315
4	15M	130, 65
5	15M	300, 160, 540, 315
6	10M	STRAIGHT
7	15M	STRAIGHT
8	15M	130, 65, VARIES
9	10M	STRAIGHT LENGTH VARIES
10	15M	225, 985, 240
11	15M	STRAIGHT

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. THIS DRAWING IS ONLY APPLICABLE IN BRIDGE REHABILITATION WHEN THE REMAINING LIFE OF THE BRIDGE IS LESS THAN 35 YEARS.
3. CONCRETE COVER TO REINFORCING STEEL 70 ±20mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE GRADE 400W.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. CONTROL JOINT TO BE FORMED.
9. SAWCUTS NOT PERMITTED.
10. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
11. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
13. LEGEND:
    EF – DENOTES EACH FACE
    IF – DENOTES INSIDE FACE
    OF – DENOTES OUTSIDE FACE
    CJ – CONSTRUCTION JOINT



TYPICAL REINFORCING ARRANGEMENT



PLAN

ELEVATION OF BARRIER WALL ON WINGWALL

A CHASE DETAIL

B CONTROL JOINT DETAIL

TYPICAL OPTIONAL CONSTRUCTION JOINT

TYPICAL EXPANSION JOINT

TYPICAL CONTROL JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING SEPTEMBER 2016	SS110-109
BARRIER WALL WITHOUT RAILING, TL-5 (BLACK STEEL REBAR)	

REVISIONS	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	DATE
DRAWN	CHK	SITE	DWG

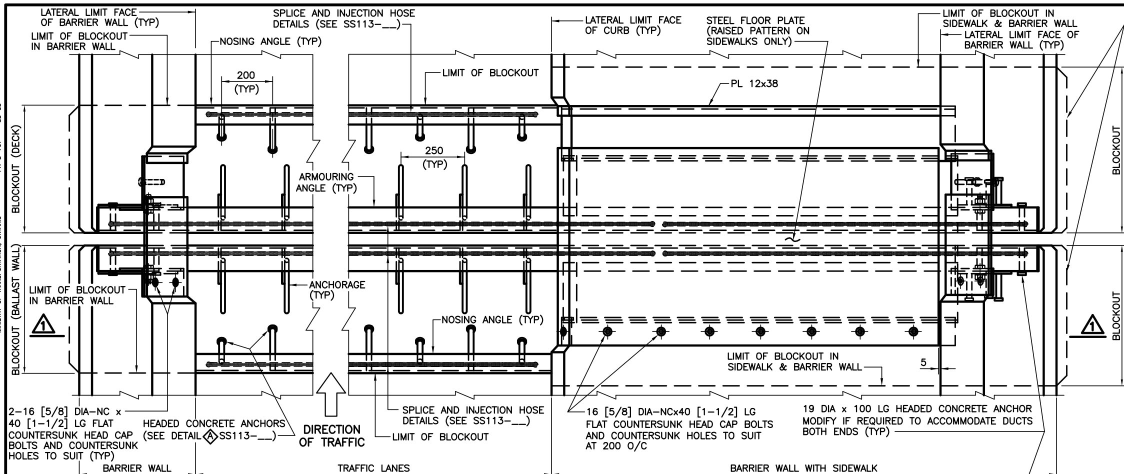
MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

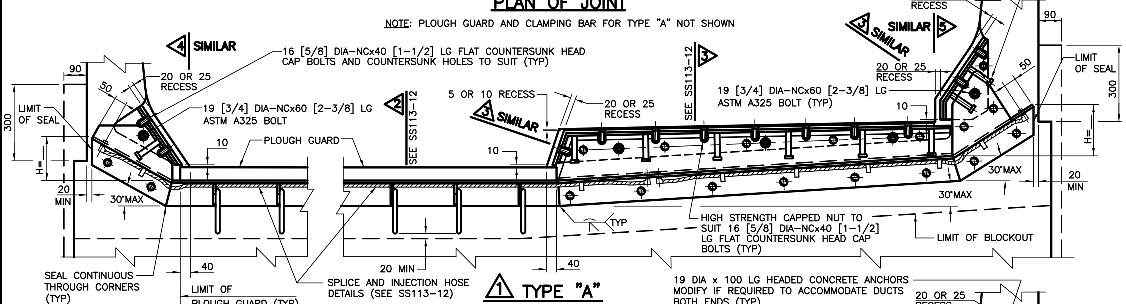
SHEET

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS

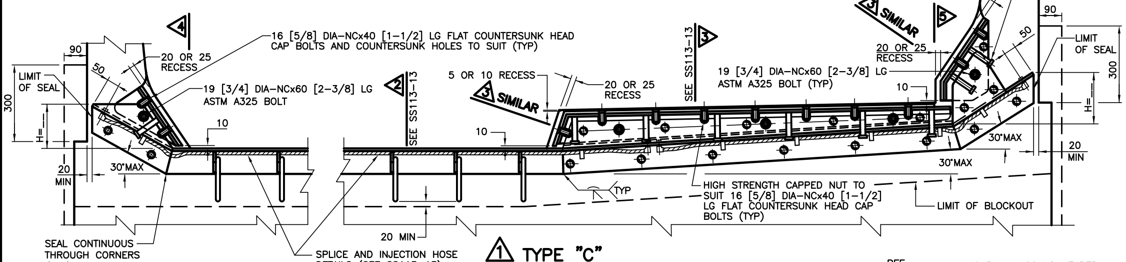


PLAN OF JOINT

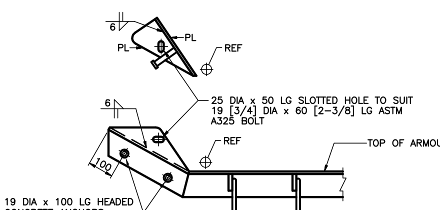
NOTE: PLOUGH GUARD AND CLAMPING BAR FOR TYPE "A" NOT SHOWN



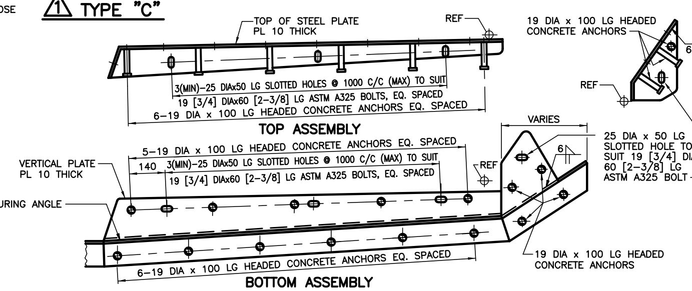
TYPE "A"



TYPE "C"



DETAILS OF ARMOURING WITHOUT SIDEWALK



DETAILS OF ARMOURING AT SIDEWALK

NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWINGS SS113–11 AND SS113–14, INSTEAD OF THIS STANDARD DRAWING.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. WHEN THE SKEW IS GREATER THAN 5° AND THE REQUIRED HEIGHT OF ARMOURING UPTURN 'H' (SEE NOTE 4) EQUALS 180mm. THE WIDTH OF DECK SHALL BE WIDENED LOCALLY BY 40mm BEYOND THE STANDARD 50mm PROJECTION. THIS LOCAL WIDENING SHALL TYPICALLY EXTEND VERTICALLY TO 300mm ABOVE TOP OF CONCRETE PROJECTION, AND LONGITUDINALLY TO THE LIMITS OF BLOCKOUT IN BARRIER WALL (SEE DASHED LIMITS ON PLAN AND SECTIONS). THIS DETAIL SHALL ALSO BE SHOWN ON THE DECK, BARRIER WALL AND ABUTMENT DRAWINGS.
4. REQUIRED HEIGHT OF UPTURN, H (mm):

	CROSSFALL SLOPE	DECK WITH CROWN		DECK WITHOUT CROWN	
WITHOUT SIDEWALK	≤ 2%	100	100	100	0
	> 2%	180	180	180	0
WITH SIDEWALK	> 0%	100	100	100	100

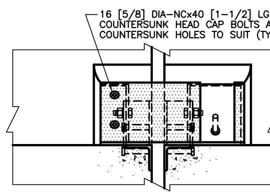
5. WHEN THE CROSSFALL SLOPES AT THE TWO ABUTMENTS ARE NOT INDENTICAL, TWO VALUES OF 'H' SHALL BE GIVEN AT EACH SIDE OF THE DECK.
6. WHERE REQUIRED, THE DESIGNER SHALL NOTE ON THE ASSEMBLY DRAWING WHETHER THE SEAL HAS TO BE TURNED UP TO AVOID CONFLICT WITH UTILITY DUCTS ON STRUCTURE REHABILITATIONS.
7. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

NOTES:

1. EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___, TYPE "_". DETAILS SHOWN FOR OTHER TYPES ARE NOT APPLICABLE.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8 SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. FOR POST–TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST–TENSIONING OPERATIONS.
14. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
15. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
16. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
17. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113–12 OR SS113–13.
18. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

ADDITIONAL NOTES FOR BOLTS:

1. 19 [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH WITH ASTM A325. ALL BOLTS USED IN 25 DIA. x 50 LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16 [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. CLAMPING BAR BOLTS FOR TYPE 'A' JOINTS SHALL BE 19 [3/4] DIAMETER HEX HEAD BOLTS IN ACCORDANCE WITH ASTM A325. CLAMPING BAR BOLTS SHALL BE TENSIONED TO 125kN.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN–OF–NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6–06.



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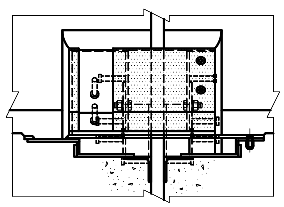


5

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
AUGUST 2015

SS113–10

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS

REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC–06	CL 625–ONT	DATE
DRAWN	CHK	SITE		DWG

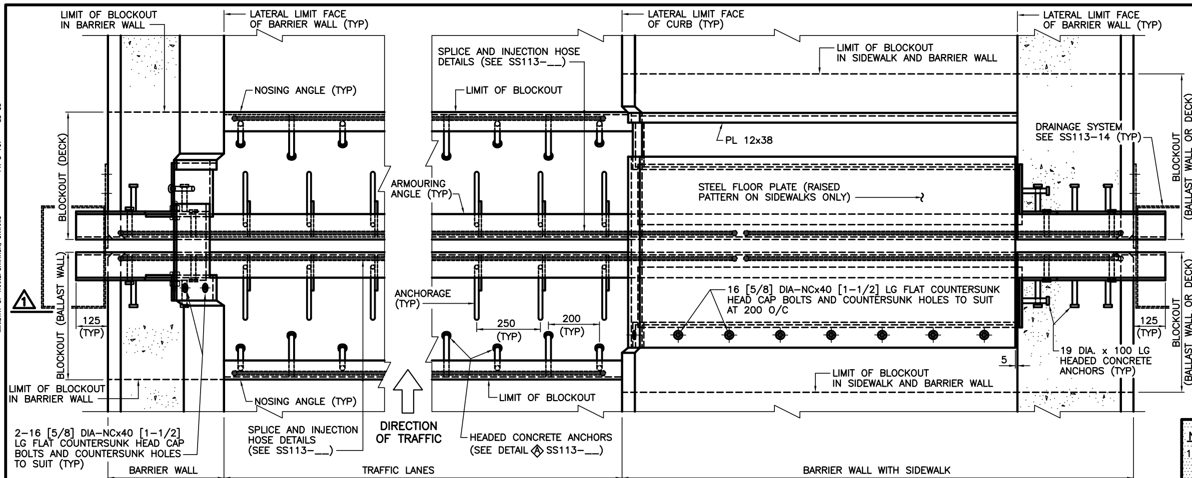
MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

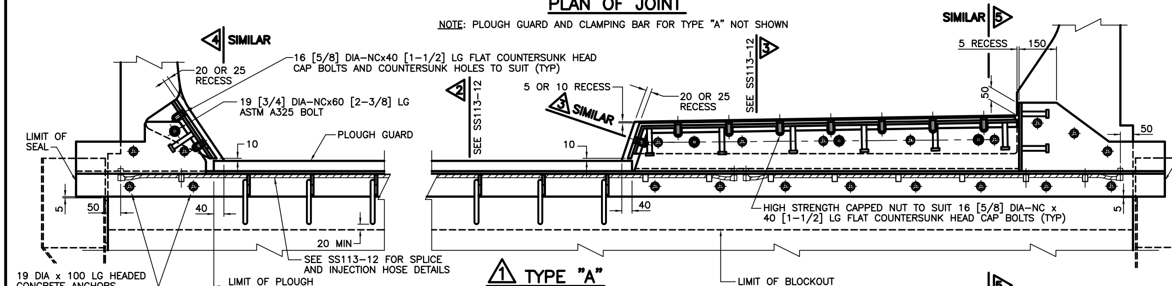
SHEET

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS – WITH DRAINAGE SYSTEM

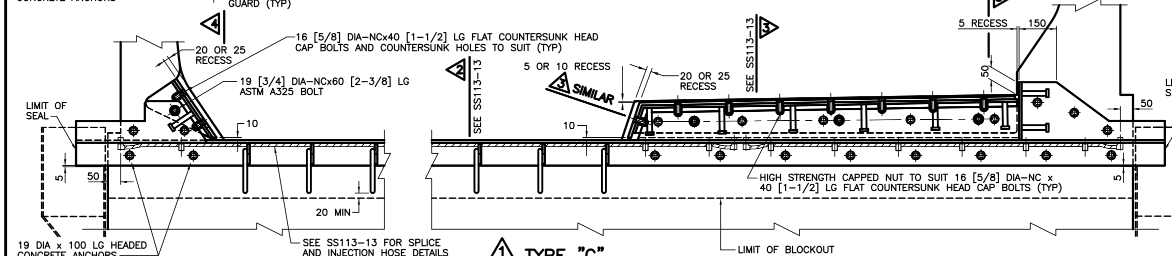


PLAN OF JOINT

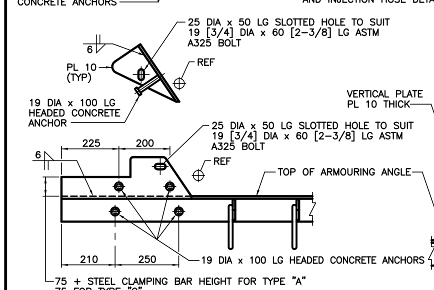
NOTE: PLOUGH GUARD AND CLAMPING BAR FOR TYPE "A" NOT SHOWN



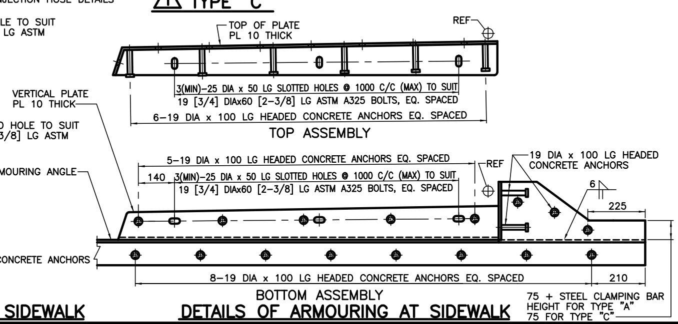
1 TYPE "A"



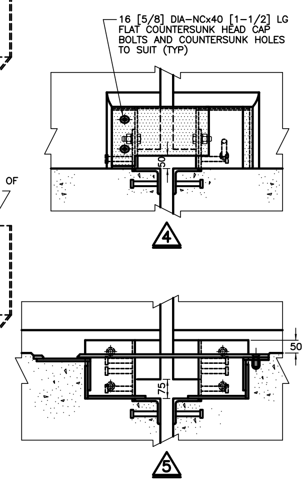
1 TYPE "C"



DETAILS OF ARMOURING WITHOUT SIDEWALK



DETAILS OF ARMOURING AT SIDEWALK



NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS NOT REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWING SS113–10, INSTEAD OF THIS STANDARD DRAWING.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

NOTES:

1. EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___, TYPE "_". DETAILS SHOWN FOR OTHER TYPES ARE NOT APPLICABLE.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   – FOR CONCRETE STRUCTURES – 48 HOURS
   – FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. FOR POST–TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST–TENSIONING OPERATIONS.
14. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
15. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
16. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
17. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113–12 OR SS113–13 AND DRAWING SS113–14.
18. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

ADDITIONAL NOTES FOR BOLTS:

1. 19 [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH WITH ASTM A325. ALL BOLTS USED IN 25 DIA. x 50 LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16 [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. CLAMPING BAR BOLTS FOR TYPE 'A' JOINTS SHALL BE 19 [3/4] DIAMETER HEX HEAD BOLTS IN ACCORDANCE WITH ASTM A325. CLAMPING BAR BOLTS SHALL BE TENSIONED TO 125kN.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN–OF–NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6–06.

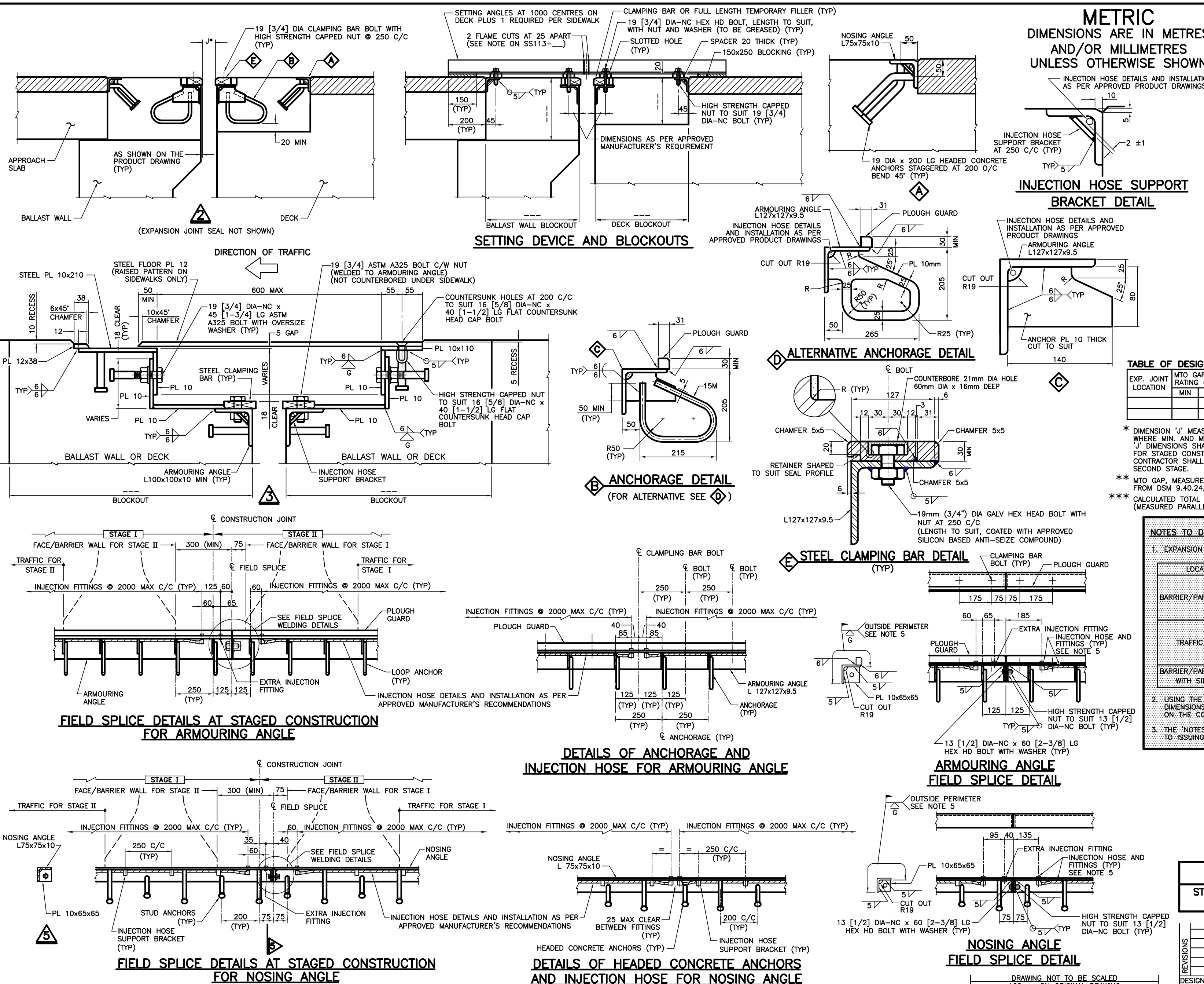
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWINGS

STANDARD DRAWING AUGUST 2015 | SS113–11

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS – WITH DRAINAGE SYSTEM

REVISIONS					
			DESCRIPTION		
DESIGN	CHK	CODE CHBDC–06	CL 625–ONT	DATE	
DRAWN	CHK	SITE		DWG	



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

STRIP SEAL EXPANSION JOINT TYPE "A" DETAILS

NOTES:

1. STEEL CLAMPING BAR SEGMENTS SHALL BE 1.3m TO 2.0m LONG. FOR STAGED EXPANSION JOINT CONSTRUCTION, STEEL CLAMPING BAR SHALL TERMINATE A MINIMUM OF 100mm FROM EXPOSED END OF STEEL ARMOURING. GAP BETWEEN ADJACENT CLAMPING BARS SHALL NOT EXCEED 3mm.
2. ALL CLAMPING BARS SHALL PREFERABLY BE ONE PIECE THROUGH ANY CHANGE IN DIRECTION, BUT AT CURB AND CURB–TO–SIDEWALK SLIDER PLATE THEY MAY BE OF MORE THAN ONE PIECE. EACH SUCH PIECE SHALL HAVE A MINIMUM OF 2 CLAMPING BOLTS.
3. FOR DETAILS OF REINFORCING IN EXPANSION JOINT BLOCKOUT, SEE DECK AND ABUTMENT REINFORCING DRAWINGS.
4. HEADED CONCRETE ANCHORS IN NOSING ANGLES SHALL BE LOCATED WITHIN 75 mm OF EITHER SIDE OF FIELD SPLICES.
5. PROTECT INJECTION HOSE AND FITTINGS ADJACENT TO FIELD SPLICE DURING WELDING AND REMOVE PROTECTION PRIOR TO PLACING OF CONCRETE IN BLOCKOUT.
6. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113–___.
7. LEGEND:
   [ ] – DENOTES FASTENER SIZE IN INCHES.

TABLE OF DESIGN REQUIREMENTS (TO BE FULLY COMPLETED BY DESIGNER)

EXP. JOINT LOCATION	MTO GAP ** RATING (mm) MIN	MAX	DESIGN *** MOVEMENT	* "J" AT INSTALLATION TEMPERATURE (C) (mm) −5°	0°	5°	10°	15°	20°	25°	30°

* DIMENSION 'J' MEASURED PERPENDICULAR TO CENTRELINE OF EXPANSION JOINT. WHERE MIN. AND MAX. FOR JOINT SUPPLIED DIFFER FROM THOSE SHOWN IN TABLE, 'J' DIMENSIONS SHALL BE REVISED BY CONTRACTOR AND SHOWN ON SHOP DRAWINGS. FOR STAGED CONSTRUCTION ON STRUCTURES OTHER THAN POST–TENSIONED, THE CONTRACTOR SHALL USE THE FIRST STAGE OBSERVED 'J' GAP TO INSTALL THE SECOND STAGE.

** MTO GAP, MEASURED BETWEEN PROJECTING FACES OF STEEL CLAMPING BAR, IS TAKEN FROM DSM 9.40.24, TYPE "A".

*** CALCULATED TOTAL MOVEMENT AT SLS OCCURRING AFTER TIME OF JOINT INSTALLATION. (MEASURED PARALLEL TO CENTRELINE OF STRUCTURE)

NOTES TO DESIGNER:

1. EXPANSION JOINT BLOCKOUT DIMENSIONS, (mm) SHALL BE AS FOLLOWS:

LOCATION	TYPE	BLOCKOUT	BALLAST WALL SIDE	DECK SIDE
BARRIER/PARAPET WALL	NEW	WIDTH	500	500
		DEPTH	335	250
	REHAB.	WIDTH	300 MIN.	300 MIN.
		DEPTH	250 MIN.	250
TRAFFIC LANES	NEW	WIDTH	500	500
		DEPTH	335	250
	REHAB.	WIDTH	300 MIN.	300 MIN.
		DEPTH	250 MIN.	250
BARRIER/PARAPET WALL WITH SIDEWALK	NEW & REHAB.	WIDTH	550	650
		DEPTH	VARIES	VARIES

2. USING THE ABOVE TABLE, THE DESIGNER SHALL FILL IN THE BLOCKOUT DIMENSIONS ON THIS DRAWING. THESE DIMENSIONS SHALL ALSO BE SHOWN ON THE CONTRACT DRAWINGS FOR DECK DETAILS AND ABUTMENT DETAILS.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

STANDARD DRAWING
APRIL 2016

SS113–12

STRIP SEAL EXPANSION JOINT – TYPE "A" DETAILS

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

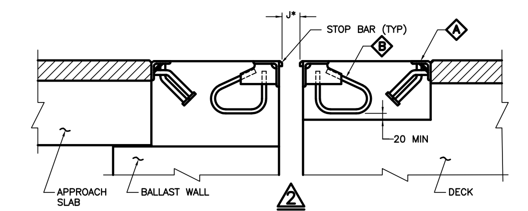
REVISIONS					
		DESCRIPTION			
DESIGN	CHK	CODE CHBDC–14	CL 625–ONT	DATE	
DRAWN	CHK	SITE		DWG	

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

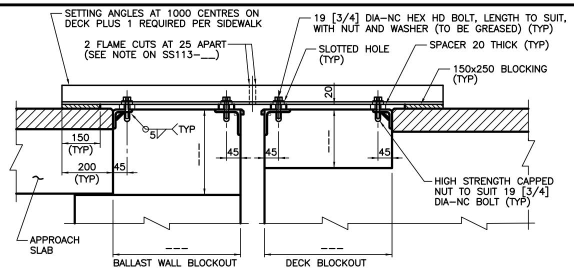
CONT No
WP No

SHEET

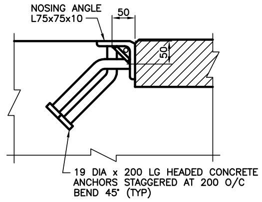
STRIP SEAL EXPANSION JOINT TYPE "C" DETAILS



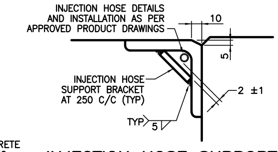
2
(EXPANSION JOINT SEAL NOT SHOWN)



SETTING DEVICE AND BLOCKOUTS

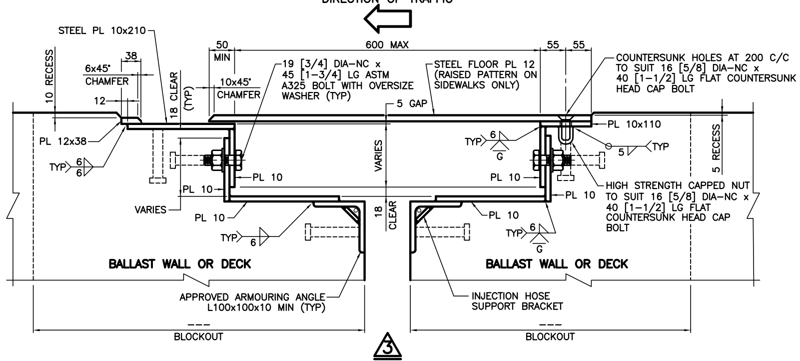


A DETAIL

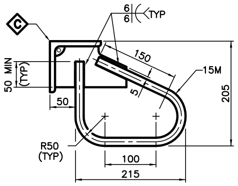


INJECTION HOSE SUPPORT BRACKET DETAIL

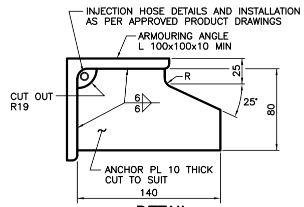
DIRECTION OF TRAFFIC



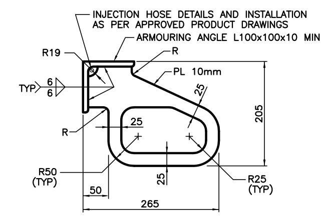
3
(STOP BARS AND RETAINER PLATES NOT SHOWN FOR CLARITY)



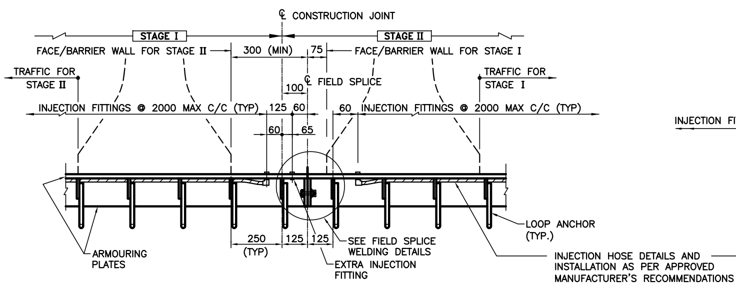
B ANCHORAGE DETAIL
FOR ALTERNATIVE SEE DETAIL D



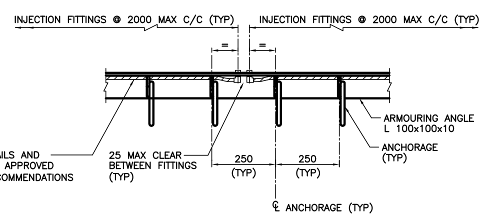
C DETAIL



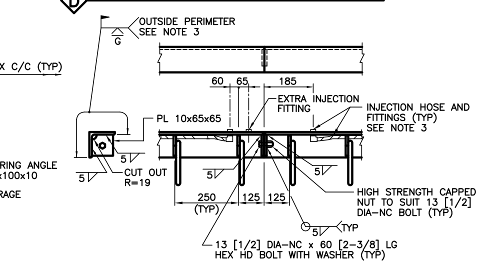
D ALTERNATIVE ANCHORAGE DETAIL



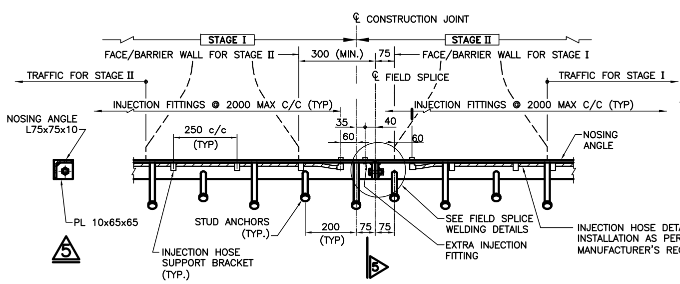
FIELD SPLICE DETAILS AT STAGED CONSTRUCTION FOR ARMOURING ANGLE



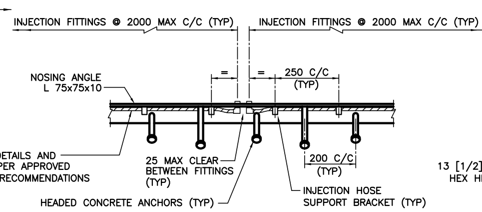
DETAILS OF ANCHORAGE AND INJECTION HOSE FOR ARMOURING ANGLE



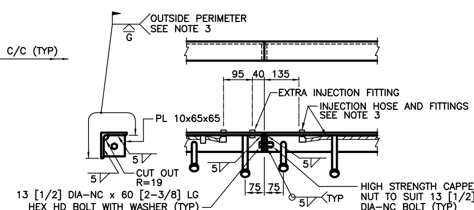
ARMOURING ANGLE FIELD SPLICE DETAIL



FIELD SPLICE DETAILS AT STAGED CONSTRUCTION FOR NOSING ANGLE



DETAILS OF HEADED CONCRETE ANCHORS AND INJECTION HOSE FOR NOSING ANGLE



NOSING ANGLE FIELD SPLICE DETAIL

NOTES:

1. FOR DETAILS OF REINFORCING IN EXPANSION JOINT BLOCKOUT, SEE DECK AND ABUTMENT REINFORCING DRAWINGS.
2. HEADED CONCRETE ANCHORS IN NOSING ANGLES SHALL BE LOCATED WITHIN 75mm OF EITHER SIDE OF FIELD SPLICES.
3. PROTECT INJECTION HOSE AND FITTINGS ADJACENT TO FIELD SPLICE DURING WELDING AND REMOVE PROTECTION PRIOR TO PLACING OF CONCRETE IN BLOCKOUT.
4. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113-__.
5. LEGEND:
   [ ] – DENOTES FASTENER SIZE IN INCHES.

TABLE OF DESIGN REQUIREMENTS (TO BE FULLY COMPLETED BY DESIGNER)

EXP. JOINT LOCATION	MTO GAP ** RATING (mm)		DESIGN *** MOVEMENT	* "J" AT INSTALLATION TEMPERATURE (C) (mm)							
	MIN	MAX		-5°	0°	5°	10°	15°	20°	25°	30°

* DIMENSION 'J' MEASURED PERPENDICULAR TO CENTRELINE EXPANSION JOINT. WHERE MIN. AND MAX. FOR JOINT SUPPLIED DIFFER FROM THOSE SHOWN IN TABLE, 'J' DIMENSIONS SHALL BE REVISED BY CONTRACTOR AND SHOWN ON SHOP DRAWINGS. FOR STAGED CONTRUCTION ON STRUCTURES OTHER THAN POST-TENSIONED, THE CONTRACTOR SHALL USE THE FIRST STAGE OBSERVED 'J' GAP TO INSTALL THE SECOND STAGE.

** MTO GAP, MEASURED BETWEEN PROJECTING FACES OF STOP BARS, IS TAKEN FROM DSM 9.40.27, TYPE "C".

*** CALCULATED TOTAL MOVEMENT AT SLS OCCURRING AFTER TIME OF JOINT INSTALLATION. (MEASURED PARALLEL TO CENTRELINE OF STRUCTURE)

NOTES TO DESIGNER:

1. EXPANSION JOINT BLOCKOUT DIMENSIONS, (mm) SHALL BE AS FOLLOWS:

LOCATION	TYPE	BLOCKOUT	BALLAST WALL SIDE	DECK SIDE
BARRIER/PARAPET WALL	NEW	WIDTH	500	500
		DEPTH	335	230
	REHAB.	WIDTH	300 MIN.	300 MIN.
		DEPTH	250 MIN.	230
TRAFFIC LANES	NEW	WIDTH	500	500
		DEPTH	335	250
	REHAB.	WIDTH	300 MIN.	300 MIN.
		DEPTH	250 MIN.	230
BARRIER/PARAPET WALL WITH SIDEWALK	NEW & REHAB.	WIDTH	550	650
		DEPTH	VARIES	VARIES

2. USING THE ABOVE TABLE, THE DESIGNER SHALL FILL IN THE BLOCKOUT DIMENSIONS ON THIS DRAWING. THESE DIMENSIONS SHALL ALSO BE SHOWN ON THE CONTRACT DRAWINGS FOR DECK DETAILS AND ABUTMENT DETAILS.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING
OCTOBER 2013

SS113-13

STRIP SEAL EXPANSION JOINT – TYPE "C" DETAILS

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION			
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

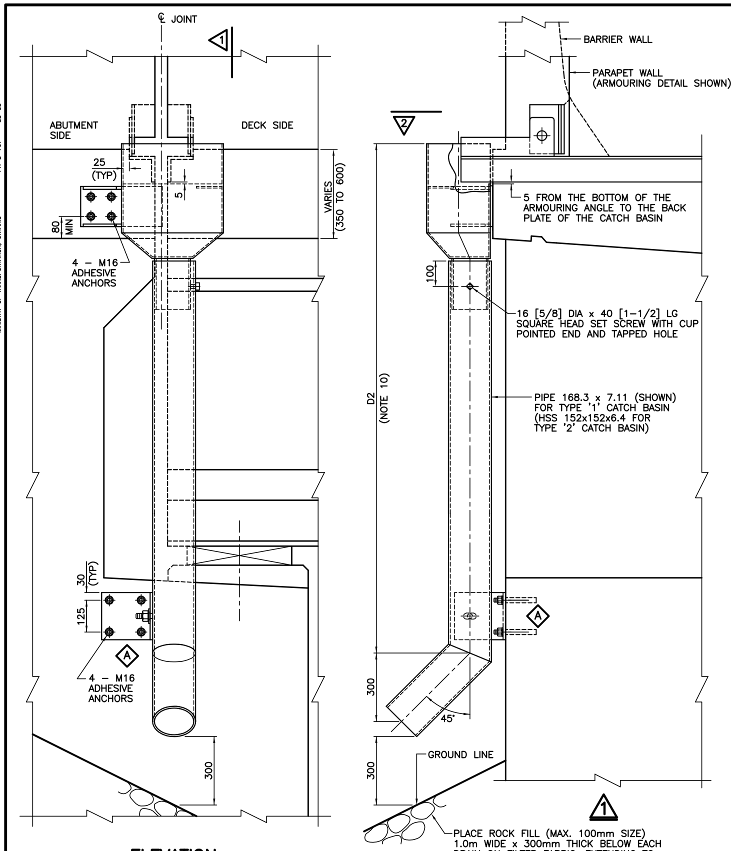
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

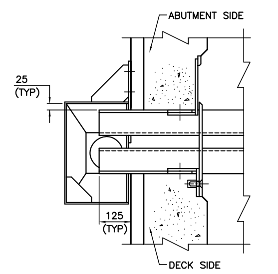
SHEET

EXPANSION JOINT DRAINAGE SYSTEM
CATCH BASIN AND DOWNPIPE – DETAILS

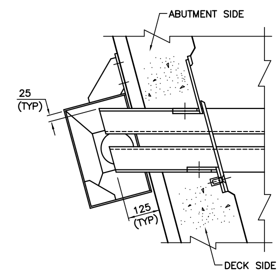


ELEVATION

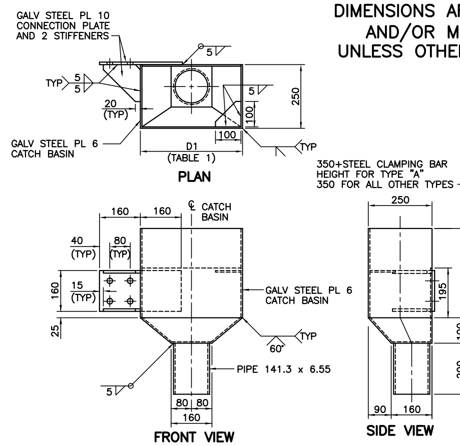
(PLOUGH GUARD AND CLAMPING BAR FOR TYPE "A" NOT SHOWN)



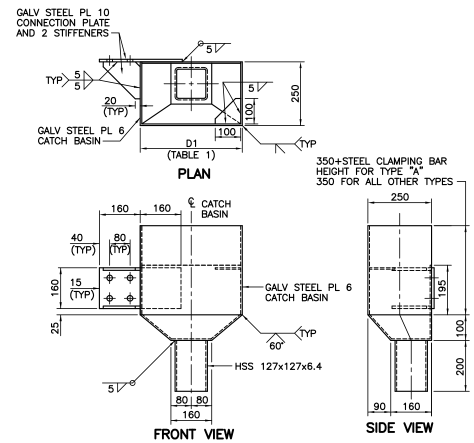
SKEW ANGLE = 0°



SKEW ANGLE > 0°



CATCH BASIN (TYPE '1') AS SHOWN
CATCH BASIN (TYPE '1') OPPOSITE HAND



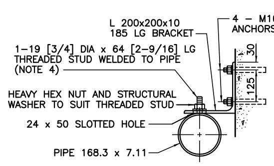
CATCH BASIN (TYPE '2') AS SHOWN
CATCH BASIN (TYPE '2') OPPOSITE HAND

NOTES:

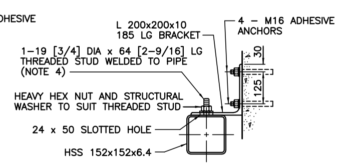
1. PIPE SHALL BE IN ACCORDANCE WITH ASTM A53 GRADE B.
2. HSS SHALL BE GRADE 350W. STEEL PLATE GRADE 350W MAY BE USED AS AN ALTERNATIVE TO HSS, PROVIDED THAT SECTIONS ARE FABRICATED USING FULL PENETRATION WELDS.
3. STEEL SHALL BE GRADE 300W UNLESS NOTED OTHERWISE.
4. THREADED STUDS SHALL BE IN ACCORDANCE WITH ASTM SPECIFICATION A108 AND CSA W59-13, USING FUSION WELD OR SHIELDED METAL ARC WELDING PROCESS.
5. ALL COMPONENTS, INCLUDING ALL CONNECTORS, SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.
6. CATCH BASIN AND DOWNPIPE SHALL BE CONNECTED TO CONCRETE USING ADHESIVE ANCHORS. THEY SHALL BE EQUIVALENT TO ASTM A325M, SIZE M16, WITH A MINIMUM EMBEDMENTLENGTH OF 100mm.
7. ADHESIVE ANCHOR INSTALLATION TO BE DONE ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
8. DETAILS OF CATCH BASIN ARE APPROPRIATE AND THE SIZE ADEQUATE FOR BRIDGES WITH ANY SKEW.
9. THIS DRAWING TO BE READ IN CONJUCTION WITH DRAWING SS113-11 (FOR BARRIER WALLS) OR SS113-16 (FOR PARAPET WALLS), OR SS113-31 (FOR BARRIER WALLS) OR SS113-34 (FOR PARAPET WALLS).
10. FOR REHABILITATION CONTRACTS, DIMENSION D2 TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR AND SHOWN ON THE SHOP DRAWINGS.
11. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

NOTES TO DESIGNER:

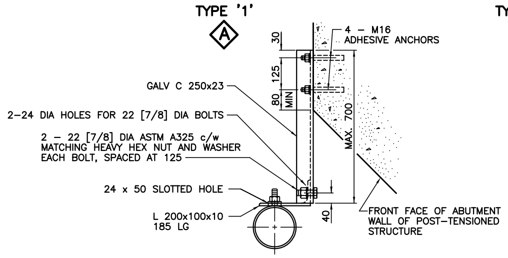
1. THIS DRAINAGE SYSTEM IS OPTIONAL AND SUBJECT TO THE APPROVAL OF THE REGIONAL STRUCTURAL SECTIONS.
2. THIS DRAWING, IN CONJUNCTION WITH DRAWINGS SS113-11 OR SS113-16 OR SS113-31 OR SS113-34, SHOULD ONLY BE USED WHEN THE FREEZING AND/OR PONDING OF WATER ON THE BRIDGE DECK IS A CONCERN. IT IS NOT TO BE USED IN AESTHETICALLY SENSITIVE LOCATIONS AND UNDERPASSES.
3. THE LENGTH OF CATCH BASIN REQUIRED, BASED ON THE SKEW OF THE BRIDGE AND THE TYPE OF EXPANSION JOINT, IS GIVEN IN TABLE 1.
4. THE DESIGNER SHALL COMPLETE TABLE 2 BASED ON TABLE 1 AND THE CONTOUR OF THE ABUTMENT BACKFILL.
5. FOR POST-TENSIONED STRUCTURES (WHICH DO NOT HAVE DECK DRAINS) CATCH BASIN(S) SHALL BE PROVIDED AT THE END(S) OF APPROACH SLABS TO RECEIVE WATER WHICH THE EXPANSION JOINT DRAINAGE SYSTEM CANNOT CONVEY.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



TYPE '1'



TYPE '2'



ALTERNATE DOWNPIPE CONNECTION TO CONCRETE

TABLE 1

SKEW ANGLE	LENGTH OF CATCH BASIN, D1 (mm) FOR STRIP SEAL	FOR SLIDING PLATE
0° TO 15°	400	450
15° TO 30°	500	550
30° TO 45°	600	650
>45°	700	750

TABLE 2

CATCH BASIN AND DOWNPIPE LOCATION	D1 (mm)	D2 (mm)

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
JULY 2014

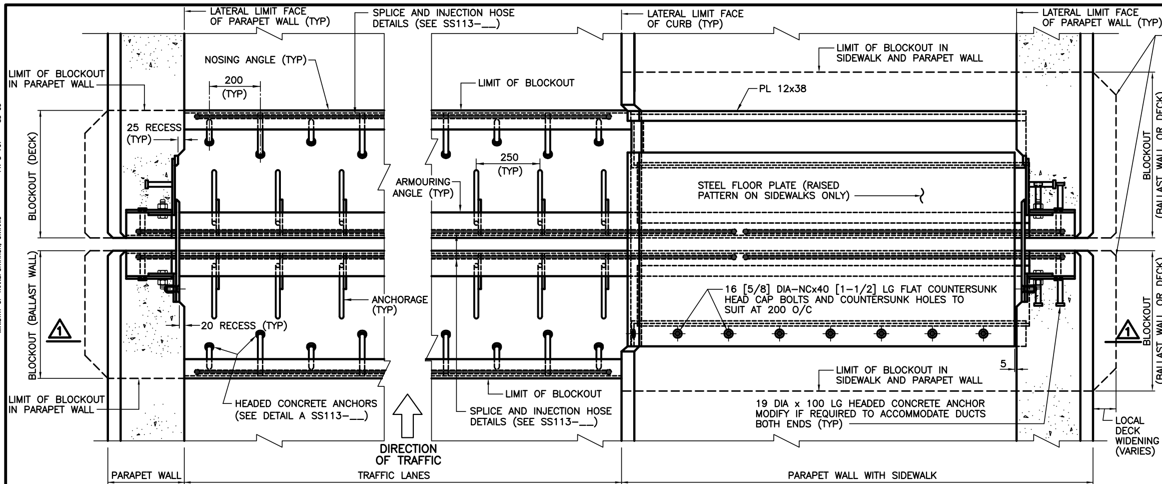
SS113-14

EXPANSION JOINT DRAINAGE SYSTEM
CATCH BASIN AND DOWNPIPE – DETAILS

REVISIONS | DESCRIPTION

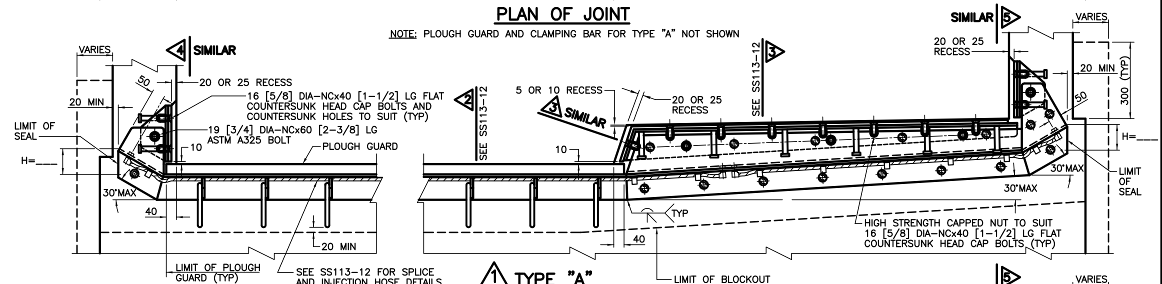
DESIGN	CHK	CODE CHBDC-00	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

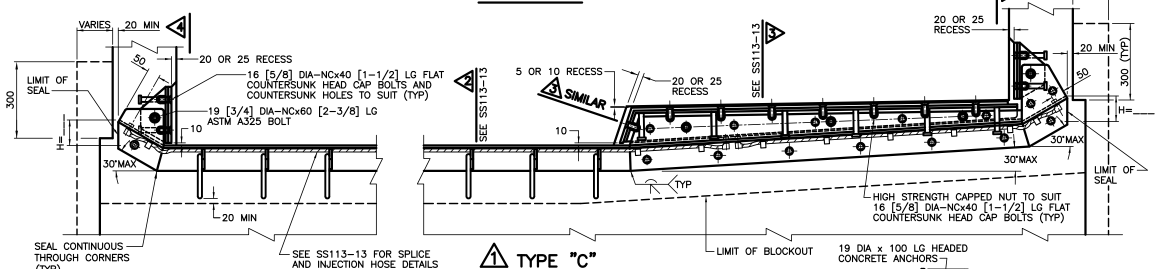


PLAN OF JOINT

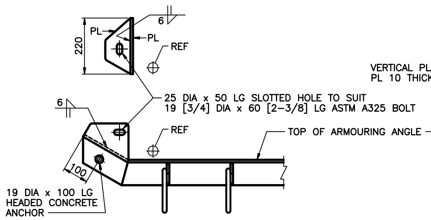
NOTE: PLOUGH GUARD AND CLAMPING BAR FOR TYPE "A" NOT SHOWN



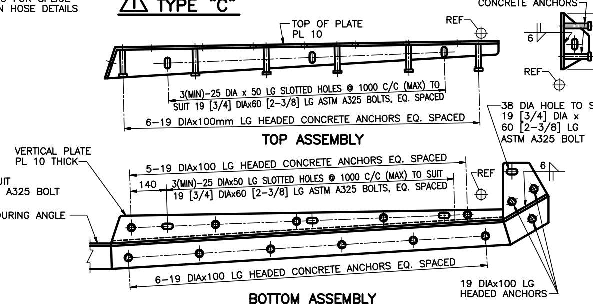
TYPE "A"



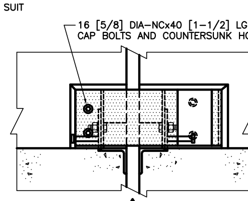
TYPE "C"



DETAIL OF ARMOURING WITHOUT SIDEWALK



DETAIL OF ARMOURING AT SIDEWALK



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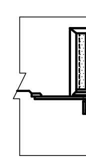


5

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS

NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWINGS SS113-16 AND SS113-14, INSTEAD OF THIS STANDARD.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING, SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. DEPENDING ON THE BRIDGE SKEW 'ψ' AND THE REQUIRED HEIGHT OF UPTURN 'H' (SEE NOTE 4), THE WIDTH OF BRIDGE DECK SHALL BE WIDENED LOCALLY BEYOND THE STANDARD 50 mm PROJECTION BY THE AMOUNT SHOWN IN THE FOLLOWING TABLE:

	REQ'D LOCAL DECK WIDENING (mm)		
SKEW \ H (mm)	0	100	180
$0° \leq \psi \leq 5°$	0	0	100
$\psi > 5°$	0	90	190

THIS LOCAL WIDENING SHALL TYPICALLY EXTEND VERTICALLY TO 300 mm ABOVE TOP OF CONCRETE PROJECTION, AND LONGITUDINALLY TO THE LIMITS OF BLOCKOUT IN BARRIER WALL. SEE DASHED LIMITS ON PLAN AND SECTIONS. THIS DETAIL SHALL ALSO BE SHOWN ON THE DECK, BARRIER WALL AND ABUTMENT DRAWINGS.

4. REQUIRED HEIGHT OF UPTURN, H (mm):

	CROSSFALL SLOPE	DECK WITH CROWN		DECK WITHOUT CROWN	
WITHOUT SIDEWALK	$\leq 2\%$	100	100	100	0
	$> 2\%$	180	180	180	0
WITH SIDEWALK	$> 0\%$	100	100	100	100

5. WHEN THE CROSSFALL SLOPES AT THE TWO ABUTMENTS ARE NOT IDENTICAL, TWO VALUES OF 'H' SHALL BE GIVEN AT EACH SIDE OF DECK.
6. WHERE REQUIRED, THE DESIGNER SHALL NOTE ON THE ASSEMBLY DRAWING WHETHER THE SEAL HAS TO BE TURNED UP TO AVOID CONFLICT WITH UTILITY DUCTS ON STRUCTURE REHABILITATIONS.
7. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

NOTES:

1. EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___, TYPE "_". DETAILS SHOWN FOR OTHER TYPES ARE NOT APPLICABLE.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. FOR POST-TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST-TENSIONING OPERATIONS.
14. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
15. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
16. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
17. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113-12 OR SS113-13.
18. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

ADDITIONAL NOTES FOR BOLTS:

1. 19 [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH WITH ASTM A325. ALL BOLTS USED IN 25 DIA. x 50 LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16 [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. CLAMPING BAR BOLTS FOR TYPE 'A' JOINTS SHALL BE 19 [3/4] DIAMETER HEX HEAD BOLTS IN ACCORDANCE WITH ASTM A325. CLAMPING BAR BOLTS SHALL BE TENSIONED TO 125kN.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN-OF-NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6-06.

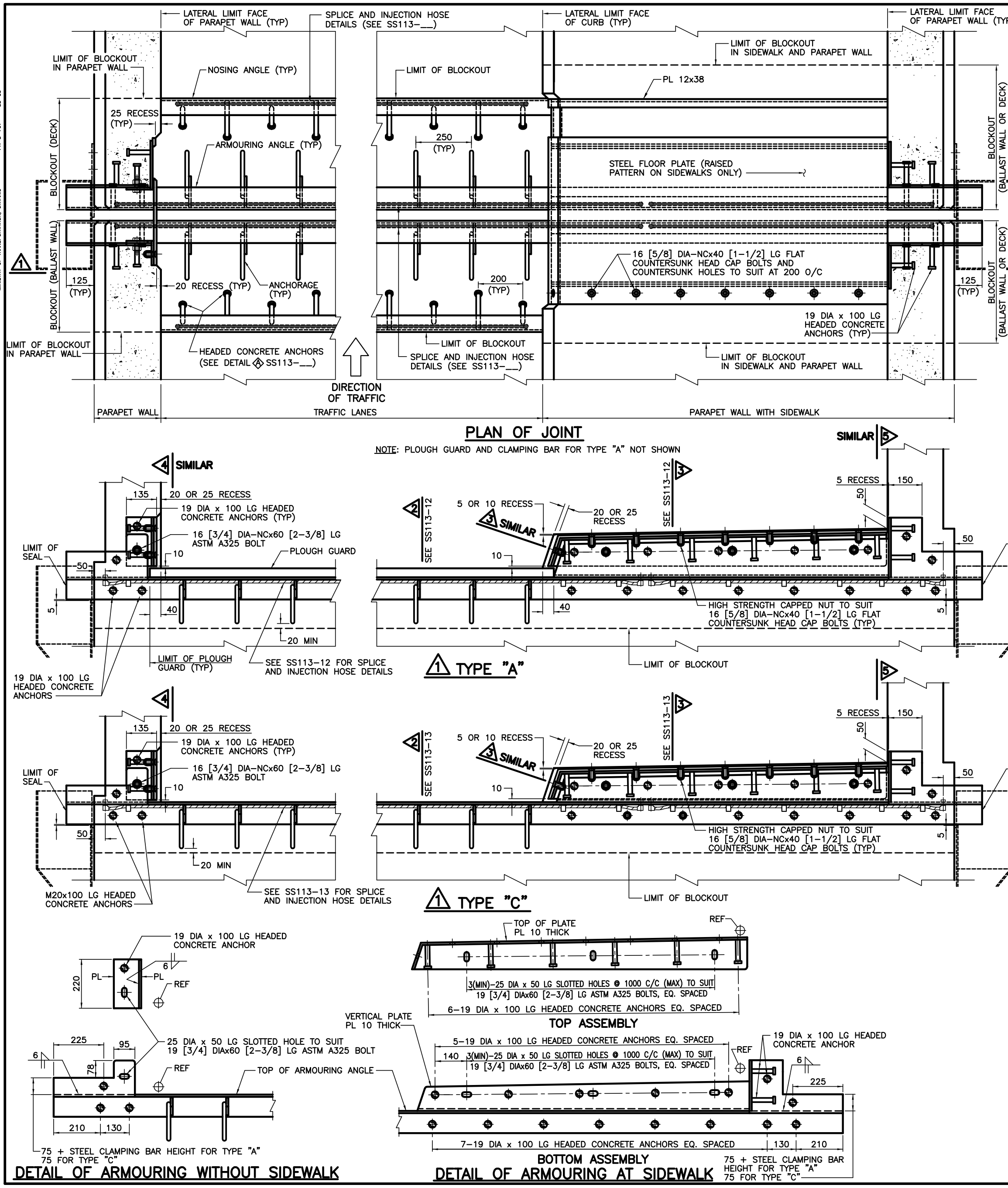
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING AUGUST 2015	SS113-15
STRIP SEAL EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS	

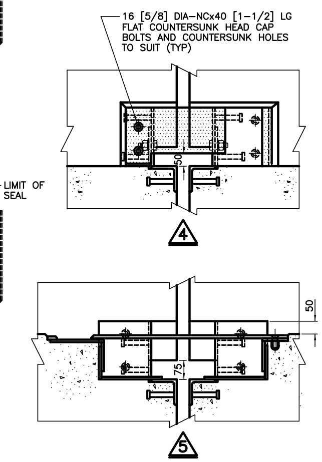
REVISIONS	DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-06	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05



NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS NOT REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWING SS113-15 INSTEAD OF THIS STANDARD.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS – WITH DRAINAGE SYSTEM

NOTES:

1. EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___, TYPE "_". DETAILS SHOWN FOR OTHER TYPES ARE NOT APPLICABLE.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. FOR POST-TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST ___ DAYS AFTER COMPLETION OF POST-TENSIONING OPERATIONS.
14. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
15. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
16. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
17. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113-12 OR SS113-13 AND DRAWING SS113-14.
18. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

ADDITIONAL NOTES FOR BOLTS:

1. 19 [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH WITH ASTM A325. ALL BOLTS USED IN 25 DIA. x 50 LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16 [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. CLAMPING BAR BOLTS FOR TYPE 'A' JOINTS SHALL BE 19 [3/4] DIAMETER HEX HEAD BOLTS IN ACCORDANCE WITH ASTM A325. CLAMPING BAR BOLTS SHALL BE TENSIONED TO 125kN.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN-OF-NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6-06.

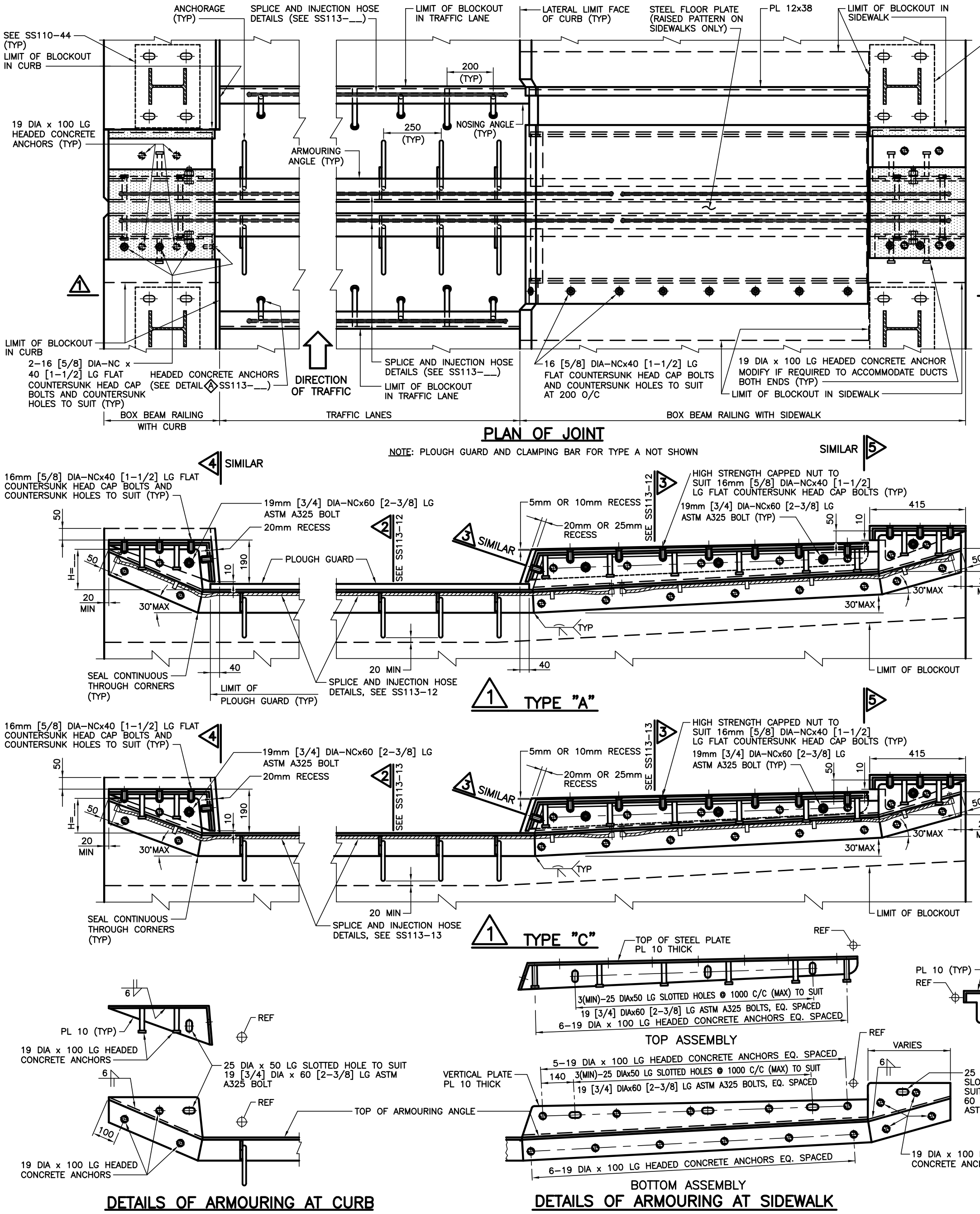
REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWINGS

STANDARD DRAWING AUGUST 2015 | SS113-16

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS – WITH DRAINAGE SYSTEM

REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC-06	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

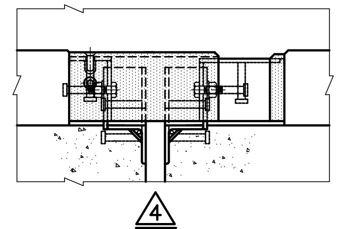
STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BOX BEAM RAILING

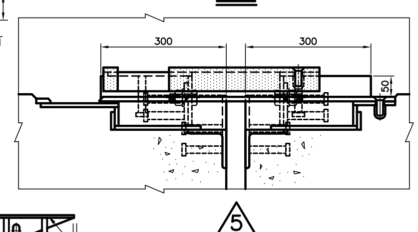
NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWING SS113–18, INSTEAD OF THIS DRAWING.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING. SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. REQUIRED HEIGHT OF UPTURN, H (mm):

	CROSSFALL SLOPE	DECK WITH CROWN		DECK WITHOUT CROWN	
WITHOUT SIDEWALK	≤ 2%	100	100	100	0
	> 2%	180	180	180	0
WITH SIDEWALK	> 0%	100	100	100	100

4. WHEN THE REQUIRED HEIGHT OF ARMOURING UPTURN "H" AT THE CURB (SEE NOTE 3) EQUALS 180mm, THE CONCRETE CURB ELEVATION SHALL BE LOCALLY RAISED BY 50mm VERTICALLY AND LONGITUDINALLY TO THE LIMITS OF BLOCKOUT IN THE CURB (SEE DASHED LIMITS ON PLAN AND SECTIONS). THIS DETAIL SHALL ALSO BE SHOWN ON THE DECK AND ABUTMENT DRAWINGS.
5. CONCRETE ELEVATION AT THE SIDEWALK SHALL BE LOCALLY RAISED BY 50mm VERTICALLY AT A WIDTH OF 415mm AND LONGITUDINALLY TO 300mm FROM THE JOINT ON EACH SIDE (SEE DASHES LIMITS ON PLAN AND SECTIONS). THIS DETAIL SHALL ALSO BE SHOWN ON THE DECK AND ABUTMENT DRAWINGS.
6. WHEN THE CROSSFALL SLOPES AT THE TWO ABUTMENTS ARE NOT IDENTICAL, TWO VALUES OF "H" SHALL BE GIVEN AT EACH SIDE OF THE DECK.
7. WHERE REQUIRED, THE DESIGNER SHALL NOTE ON THE ASSEMBLY WHETHER THE SEAL HAS TO BE TURNED UP TO AVOID CONFLICT WITH UTILITIES DUCTS ON STRUCTURE REHABILITATIONS.
8. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.





NOTES:

1. EXPANSION JOINT SHALL BE ACCORDING TO THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___, TYPE "_". DETAILS SHOWN FOR OTHER TYPES ARE NOT APPLICABLE.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. FOR POST–TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST–TENSIONING OPERATIONS.
14. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
15. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
16. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
17. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113–12 OR SS113–13.
18. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

ADDITIONAL NOTES FOR BOLTS:

1. 19mm [3/4] DIAMETER BOLTS SHALL BE ACCORDING TO ASTM A325. ALL BOLTS USED IN 25mm DIA x 50mm LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16mm [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE ACCORDING TO ASTM F835.
3. CLAMPING BAR BOLTS FOR TYPE 'A' JOINTS SHALL BE 19 [3/4] DIAMETER HEX HEAD BOLTS IN ACCORDANCE WITH ASTM A325. CLAMPING BAR BOLTS SHALL BE TENSIONED TO 125kN.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN–OF–NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6–06.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
AUGUST 2015

SS113–17

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BOX BEAM RAILING

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC–06	CL 625–ONT	DATE
DRAWN	CHK	SITE		DWG

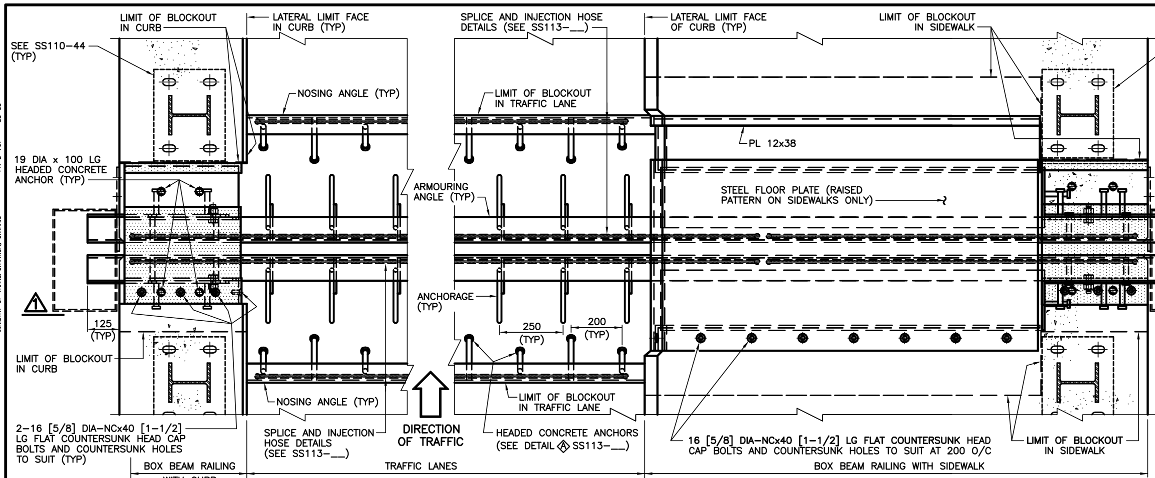
MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

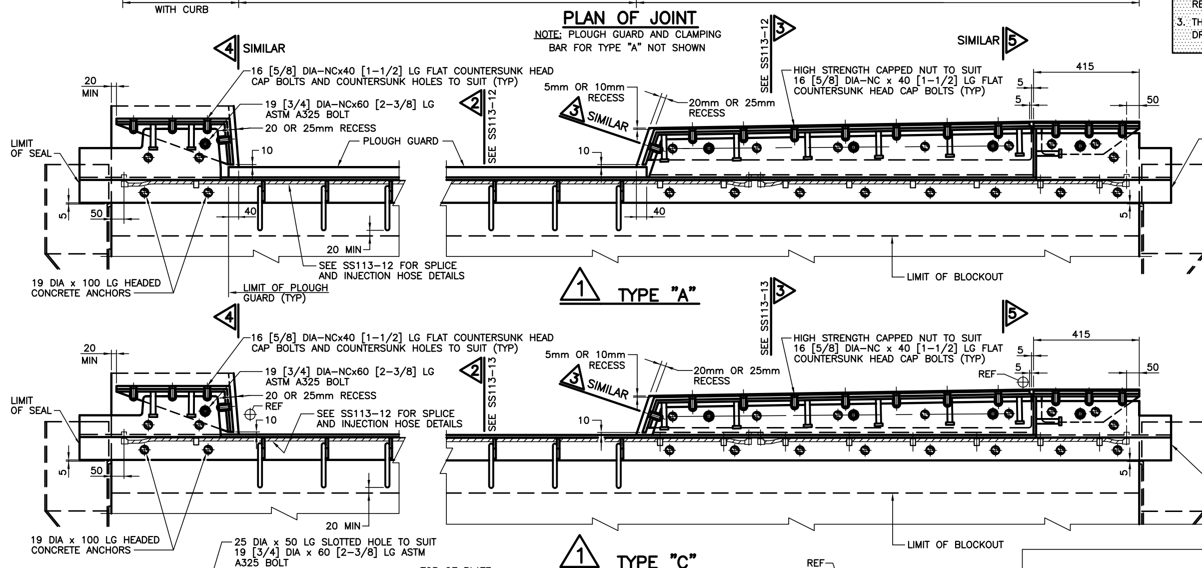
SHEET

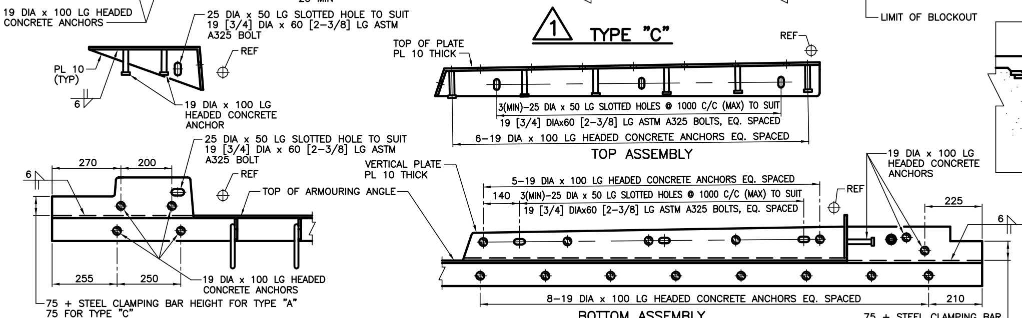
STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BRIDGE WITH BOX BEAM RAILING AND DRAINAGE SYSTEM



PLAN OF JOINT

NOTE: PLOUGH GUARD AND CLAMPING BAR FOR TYPE "A" NOT SHOWN



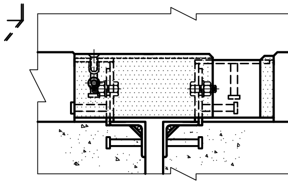


DETAILS OF ARMOURING AT CURB

DETAILS OF ARMOURING AT SIDEWALK

NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINT IS NOT REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWING SS113-17, INSTEAD OF THIS STANDARD DRAWING.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING. SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



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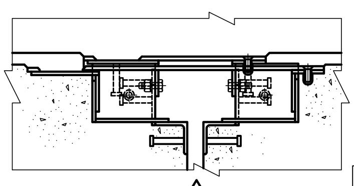


5

NOTES:

1. EXPANSION JOINT SHALL BE ACCORDING TO THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.___, TYPE "_". DETAILS SHOWN FOR OTHER TYPES ARE NOT APPLICABLE.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. FOR POST-TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST-TENSIONING OPERATIONS.
14. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
15. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
16. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS: STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
17. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING SS113-12 OR SS113-13 AND DRAWING SS113-14.
18. LEGEND: [ ] DENOTES FASTENER SIZE IN INCHES.

ADDITIONAL NOTES FOR BOLTS:

1. 19mm [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH ASTM A325. ALL BOLTS USED IN 25mm DIA. x 50mm LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16mm [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. CLAMPING BAR BOLTS FOR TYPE 'A' JOINTS SHALL BE 19 [3/4] DIAMETER HEX HEAD BOLTS IN ACCORDANCE WITH ASTM A325. CLAMPING BAR BOLTS SHALL BE TENSIONED TO 125 kN.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN-OF-NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6-06.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWINGS

STANDARD DRAWING AUGUST 2015

SS113-18

STRIP SEAL EXPANSION JOINT ASSEMBLY FOR BRIDGE WITH BOX BEAM RAILING AND DRAINAGE SYSTEM

REVISIONS | DESCRIPTION

DESIGN | CHK | CODE CHBDC-06 | CL 625-ONT | DATE
DRAWN | CHK | SITE | | DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

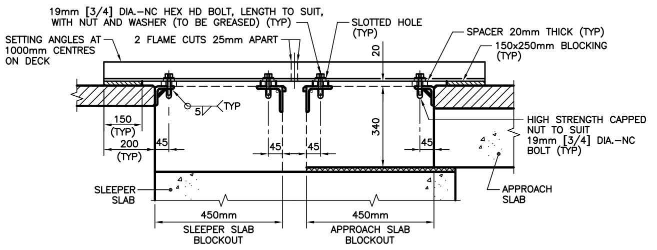
MINISTRY OF TRANSPORTATION, ONTARIO
PH-D-707 88-05

METRIC

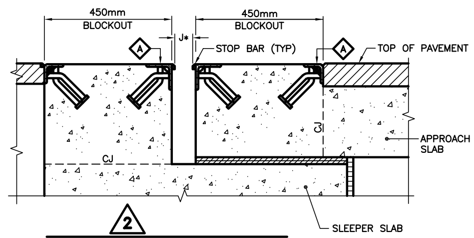
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

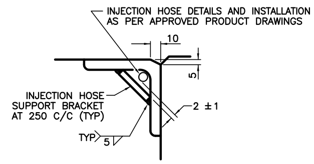
CONT No WP No	SHEET
STRIP SEAL EXPANSION JOINT FOR SLEEPER SLAB	



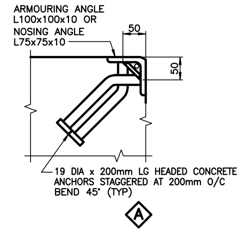
SETTING DEVICE AND BLOCKOUTS



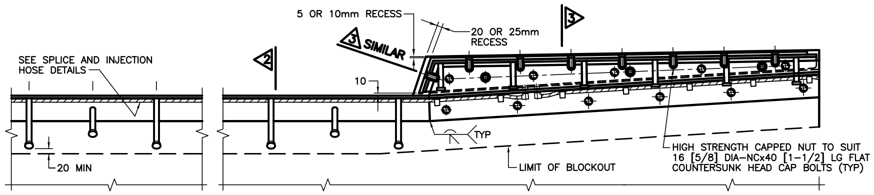
2
(EXPANSION JOINT SEAL NOT SHOWN)



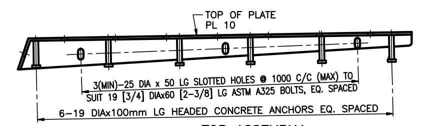
INJECTION HOSE SUPPORT BRACKET DETAIL



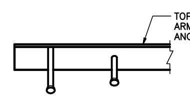
A



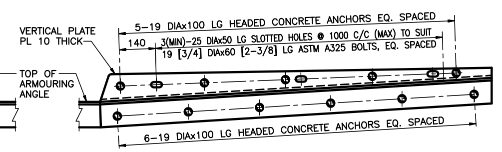
SECTION AT EXPANSION JOINT



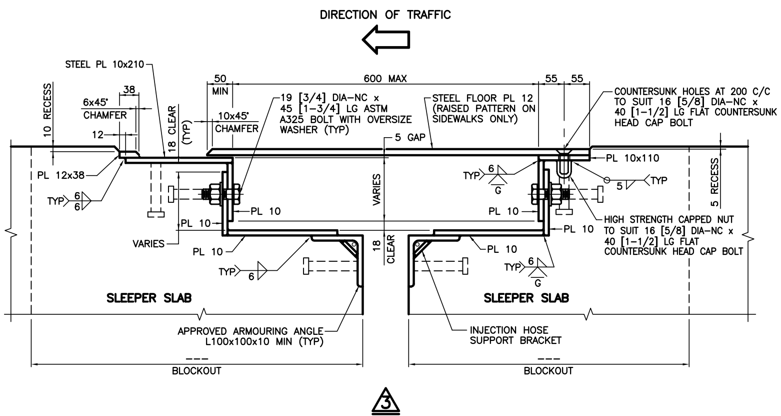
TOP ASSEMBLY



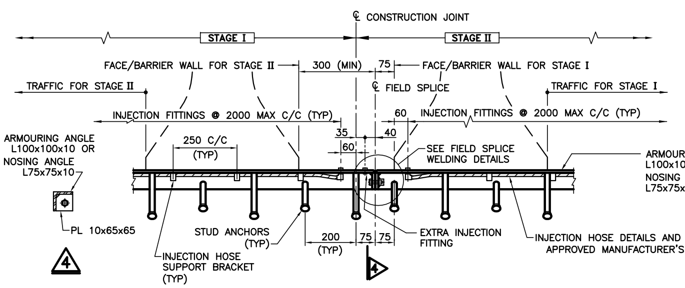
DETAIL OF ARMOURING WITHOUT SIDEWALK



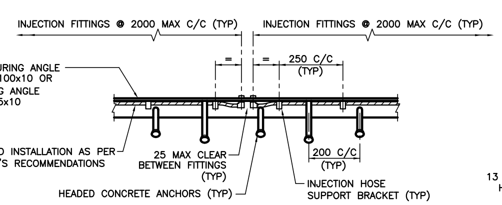
BOTTOM ASSEMBLY
DETAIL OF ARMOURING AT SIDEWALK



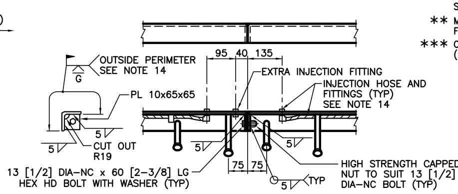
3
(STOP BARS AND RETAINER PLATES NOT SHOWN FOR CLARITY)



FIELD SPLICE DETAILS AT STAGED CONSTRUCTION FOR ARMOURING AND NOSING ANGLES



DETAILS OF HEADED CONCRETE ANCHORS AND INJECTION HOSE FOR ARMOURING AND NOSING ANGLES



ARMOURING AND NOSING ANGLES FIELD SPLICE DETAIL

NOTES:

1. THIS DRAWING SHOWS EXPANSION JOINT AND SLEEPER SLAB AT THE END OF APPROACH SLAB OF INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES WITH A MOVEMENT BETWEEN 10 AND 40MM.
2. EXPANSION JOINT TO BE SUPPLIED BY MANUFACTURERS LISTED IN DSM 9.40.27 FOR THE SUPPLY OF TYPE 'C' STRIP SEAL EXPANSION JOINT.
3. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
4. JOINT ASSEMBLY SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
5. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS: – FOR CONCRETE STRUCTURES – 48 HOURS – FOR STEEL STRUCTURES – 24 HOURS
6. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
7. IF THE JOINT ARMOURING FOR A SKEW STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
8. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
10. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
11. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
12. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST, STYROFOAM OR FILLER BETWEEN APPROACH SLAB AND SLEEPER SLAB REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
13. PROTECT INJECTION HOSE AND FITTINGS ADJACENT TO FIELD SPLICE DURING WELDING AND REMOVE PROTECTION PRIOR TO PLACING OF CONCRETE IN BLOCKOUT.
14. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE APPROACH SLAB SIDE AND THE SLEEPER SLAB SIDE EXCEPT STRUCTURE SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE APPROACH SLAB SIDE.
15. LEGEND: [ ] DENOTED FASTENER SIZE IN INCHES
    EJ – DENOTES EXPANSION JOINT

ADDITIONAL NOTES FOR BOLTS:

1. 19 [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH ASTM A325. ALL BOLTS USED IN 25 DIA. x 50 LONG SLOTTED HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16 [5/8] DIAMETER FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
4. ALL BOLTS SHALL BE TENSIONED USING THE TURN-OF-NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6-14.

TABLE OF DESIGN REQUIREMENTS (TO BE FULLY COMPLETED BY DESIGNER)

EXP. JOINT LOCATION	MTO GAP ** RATING (mm) MIN	MTO GAP ** RATING (mm) MAX	DESIGN *** MOVEMENT	* "J" AT INSTALLATION TEMPERATURE (C) (mm) –5°	0°	5°	10°	15°	20°	25°	30°

* DIMENSION 'J' MEASURED PERPENDICULAR TO CENTRELINE OF EXPANSION JOINT. WHERE MIN. AND MAX. FOR JOINT SUPPLIED DIFFER FROM THOSE SHOWN IN TABLE, 'J' DIMENSIONS SHALL BE REVISED BY CONTRACTOR AND SHOWN ON SHOP DRAWINGS. FOR STAGED CONSTRUCTION ON STRUCTURES OTHER THAN POST-TENSIONED, THE CONTRACTOR SHALL USE THE FIRST STAGE OBSERVED 'J' GAP TO INSTALL THE SECOND STAGE.

** MTO GAP, MEASURED BETWEEN PROJECTING FACES OF STEEL CLAMPING BAR, IS TAKEN FROM DSM 9.40.27, TYPE "C".

*** CALCULATED TOTAL MOVEMENT AT SLS OCCURRING AFTER TIME OF JOINT INSTALLATION. (MEASURED PARALLEL TO CENTRELINE OF STRUCTURE)

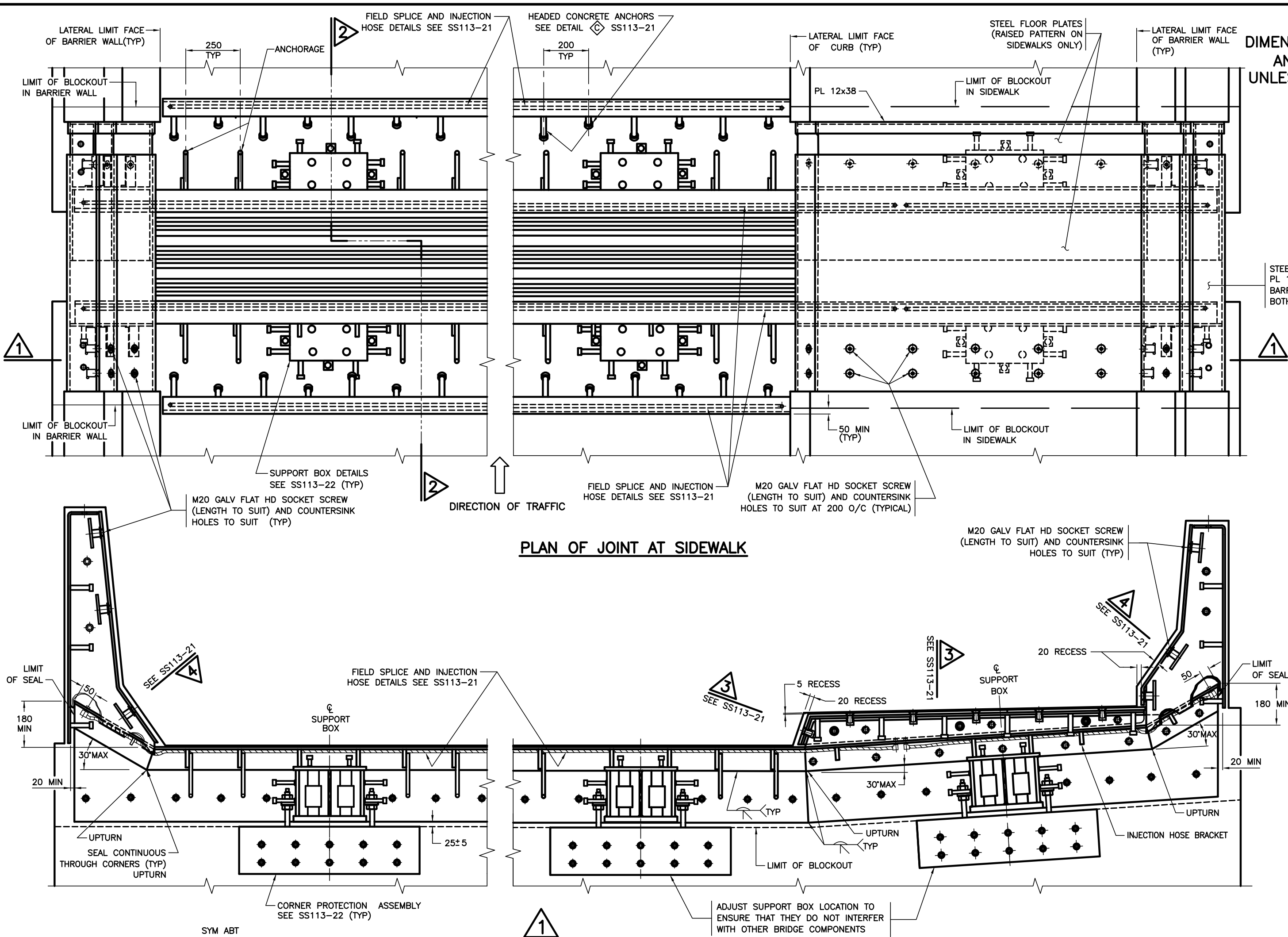
STANDARD DRAWING SEPTEMBER 2016	SS113–19
STRIP SEAL EXPANSION JOINT FOR SLEEPER SLAB	

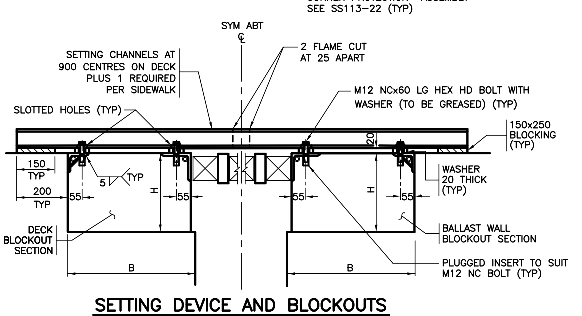
REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC–14	CL 625–ON	DATE
DRAWN	CHK	SITE		DWG

CONT No
WP No

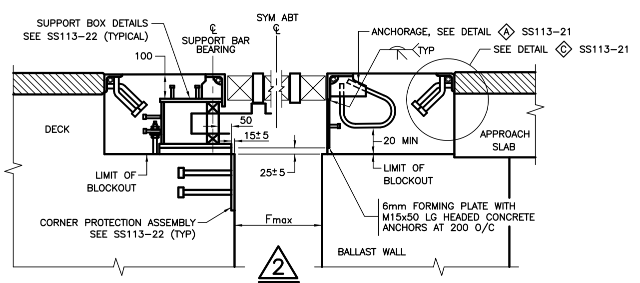
SHEET

MODULAR EXPANSION JOINT WITH INJECTION HOSE SYSTEM–ASSEMBLY





SETTING DEVICE AND BLOCKOUTS



NOTES:

1. EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCE FOR MATERIALS LIST DSM 9.40.20 AND SHALL HAVE A RATED TOTAL MOVEMENT CAPACITY OF ___ mm.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
4. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
5. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
6. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
7. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
8. SETTING CHANNELS SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
9. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING SHALL THEN BE PRESSURE INJECTED.
10. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
11. THE USE OF HOLLOW SEPARATION BEAMS IS NOT PERMITTED. SHOP SPLICING OF SEPARATION BEAM IS PERMITTED ONLY AT ROADWAY CROWN, UPTURNS AND AT ONE ADDITIONAL LOCATION BETWEEN THE CROWN AND THE UPTURN. SHOP SLICES BETWEEN THE UPTURNS SHALL BE FULL STRENGTH.
12. ENDS OF BOX SEAL SHALL BE SEALED WITH BITUTHENE PREFORMED SHEET TO PREVENT ENTRANCE OF WATER OR FOREIGN MATTER.
13. FOR POST–TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST ___ DAYS AFTER COMPLETION OF POST–TENSIONING OPERATIONS.
14. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113–21 AND SS113–22.

TABLE OF DESIGN REQUIREMENTS

EXP JOINT LOCATION	DESIGN ** MOVEMENT (mm)	* DIMENSIONS (mm)		Fmax (mm)
		B	H	

* DIMENSIONS MEASURED PERPENDICULAR TO CENTRELINE EXPANSION JOINT. WHERE DIMENSION REQUIRED FOR JOINT SUPPLIED DIFFERS FROM THAT SHOWN IN TABLE, DIMENSION SHALL BE REVISED BY CONTRACTOR AND SHOWN ON SHOP DRAWINGS.

** CALCULATED TOTAL MOVEMENT @ SLS OCCURRING AFTER TIME OF JOINT INSTALLATION (MEASURED PARALLEL TO CENTRELINE OF STRUCTURE).

NUMBER OF SEALS	3	4	5	6	7	8
"B"mm	675	760	835	915	995	1075
"H"mm(MIN)	355	355	355	380	380	380

NOTES TO DESIGNER:

1. $F_{max} = 250mm + \Delta max$
   Δmax = MAXIMUM MOVEMENT DUE TO TEMPERATURE FALL FROM 15°C + CREEP AND SHRINKAGE WHERE APPLICABLE.
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING AUGUST 2015	SS113–20
MODULAR EXPANSION JOINT WITH INJECTION HOSE SYSTEM – ASSEMBLY	

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC–06	CL 625–ONT	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05

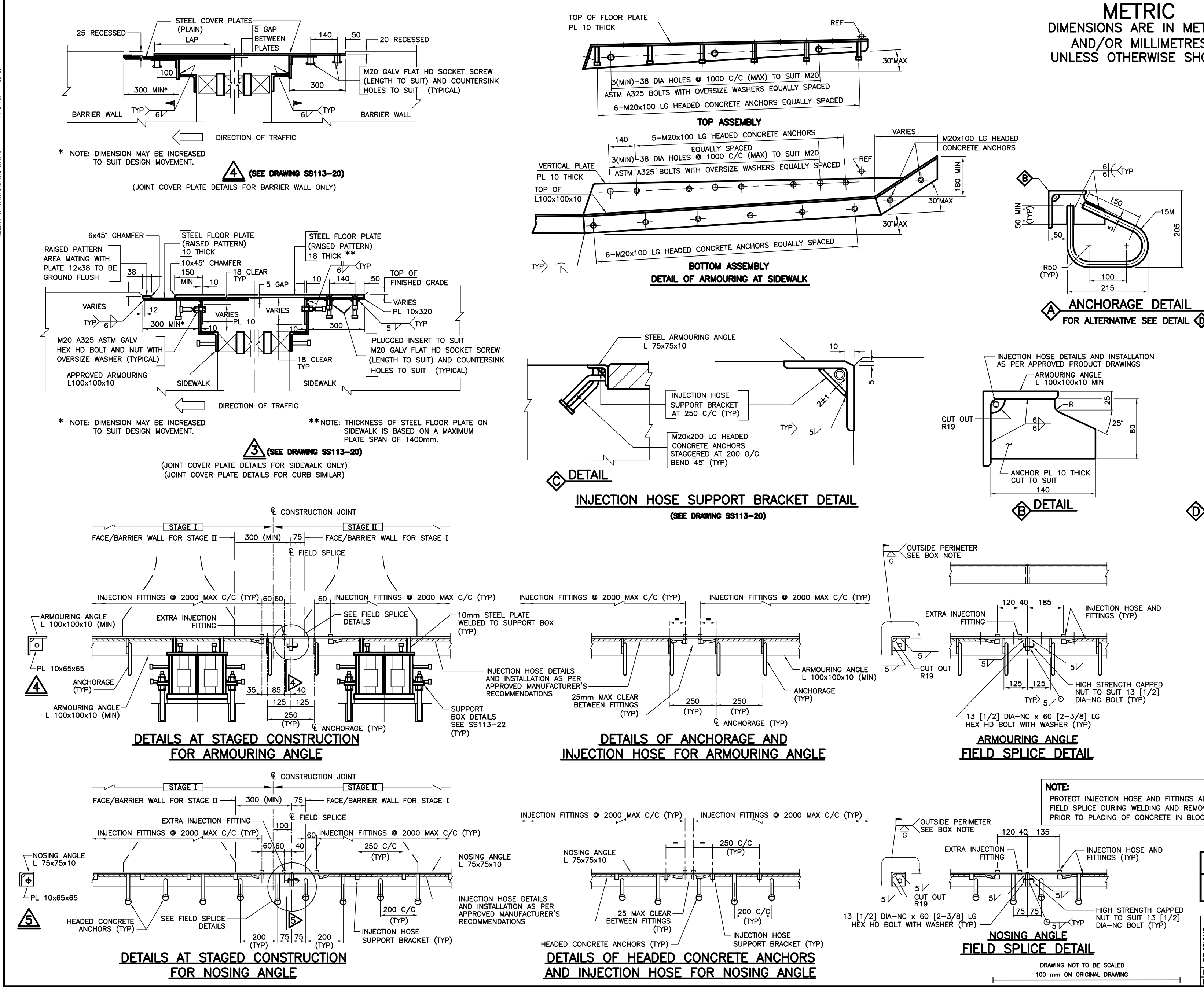
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

MODULAR EXPANSION JOINT WITH INJECTION HOSE SYSTEM – DETAILS I



NOTES:

1. INSTALL THREADED ANCHORS (WITH LEVELLING NUTS) THROUGH EYELETS LOCATED ON THREE SIDES OF BOXES. FILL HOLES WITH EPOXY AFTER INSTALLATION OF ANCHORS.
2. ADJUST THE ELEVATION OF EXPANSION JOINT BY MEANS OF TWO LEVELLING NUTS ON THE THREADED ANCHORS.
3. INJECT NON-SHRINK GROUT UNDER THE SUPPORT BOX AT A PRESSURE OF 10 kPa.
4. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113–20 AND SS113–22.

NOTE:
PROTECT INJECTION HOSE AND FITTINGS ADJACENT TO FIELD SPLICE DURING WELDING AND REMOVE PROTECTION PRIOR TO PLACING OF CONCRETE IN BLOCKOUT.

STANDARD DRAWING JAN 2013 — SS113–21

MODULAR EXPANSION JOINT WITH INJECTION HOSE SYSTEM – DETAILS I

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

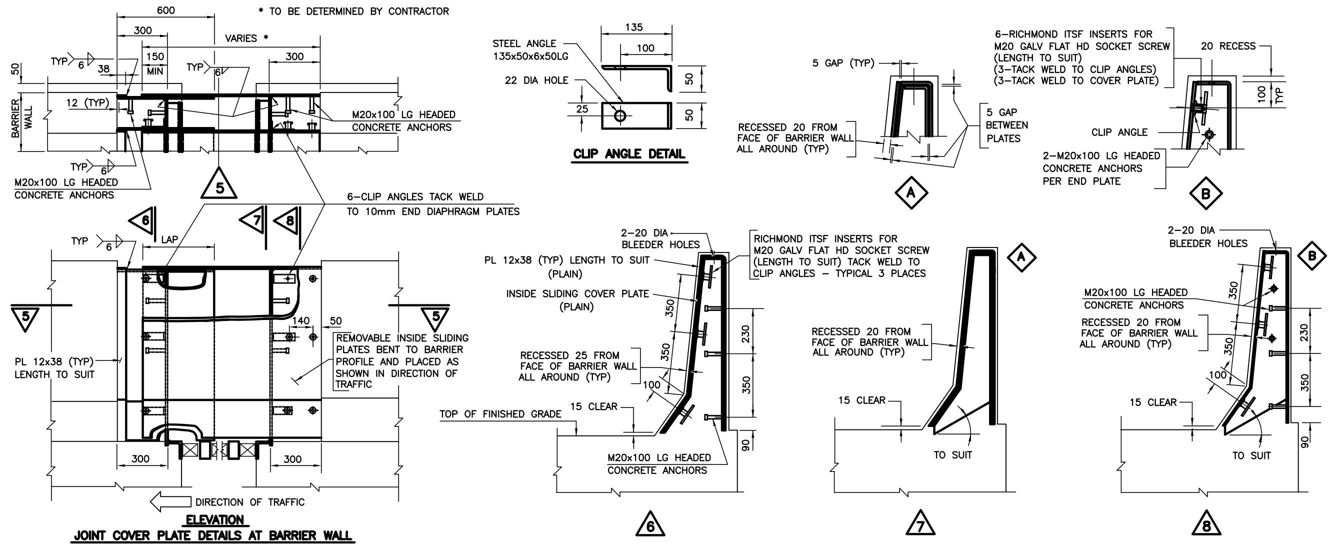
DESIGN	CHK	CODE CHBDC–00	LOAD	DATE
DRAWN	CHK	SITE		DWG

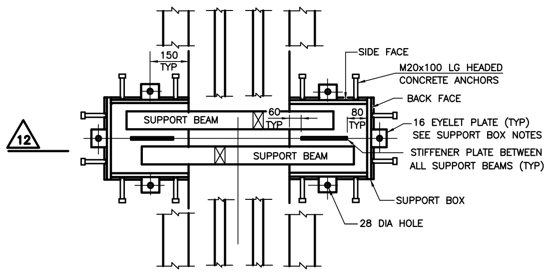
MINISTRY OF TRANSPORTATION, ONTARIO PH–D–707 88–05

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

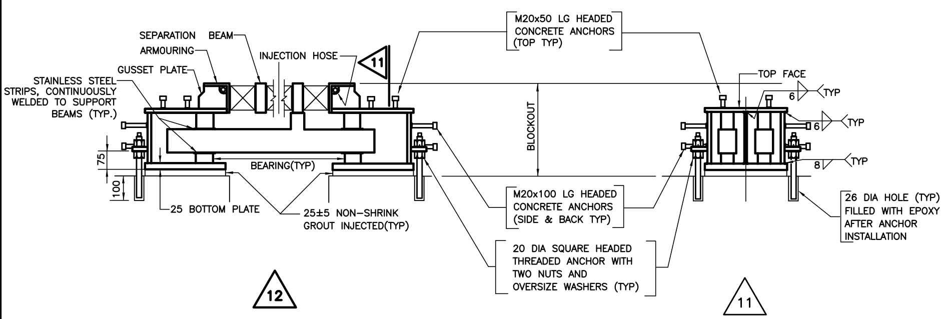
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No	
WP No	SHEET
MODULAR EXPANSION JOINT WITH INJECTION HOSE SYSTEM – DETAILS II	





SECTION PLAN



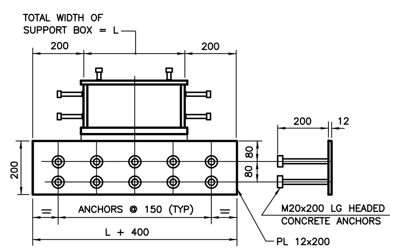
SUPPORT BOX DETAILS
(DETAILS SHOWN FOR 3 CELL EXPANSION JOINT ASSEMBLY, ALL OTHERS SIMILAR)

GENERAL NOTES:

- THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113-20 AND SS113-21.

SUPPORT BOX NOTES:

1. PROVIDE HEADED CONCRETE ANCHORS, 4 ON EACH SIDE FACE. PROVIDE HEADED CONCRETE ANCHORS, 2 PER SUPPORT BEAM ON BOTH TOP AND BACK FACES (MIN. HEADED CONCRETE ANCHORS PER FACE TO BE 4).
2. STEEL PLATE 10mm MINIMUM UNLESS OTHERWISE NOTED.
3. FOR 4, 5 AND 6 SEAL MODULAR JOINTS, ALL SUPPORT BOXES SHALL BE SUPPLIED WITH 2 EYELETS ON THE BACK FACE.

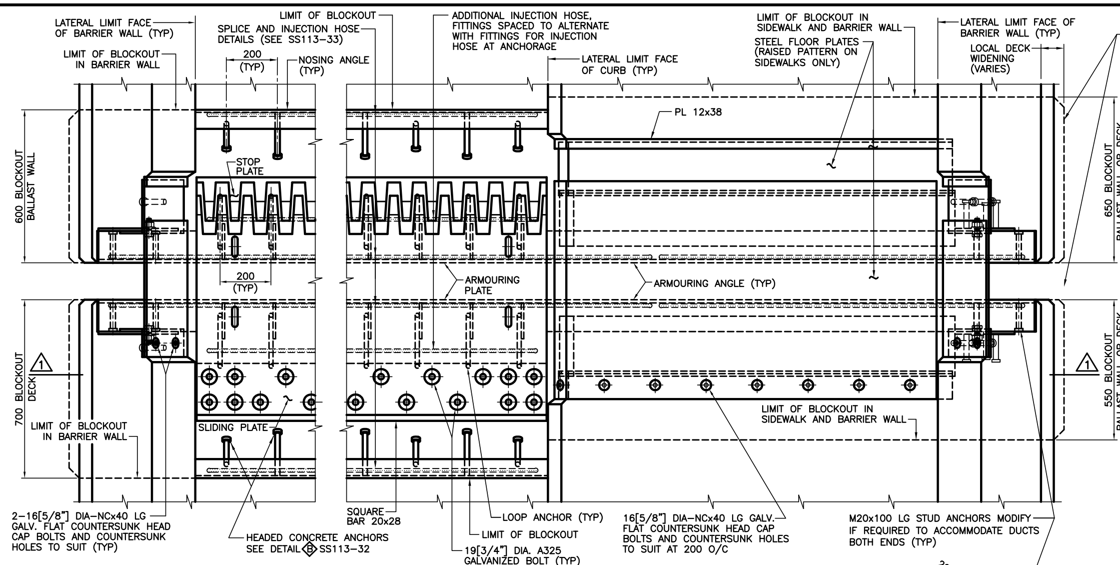


CORNER PROTECTION ASSEMBLY DETAILS

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

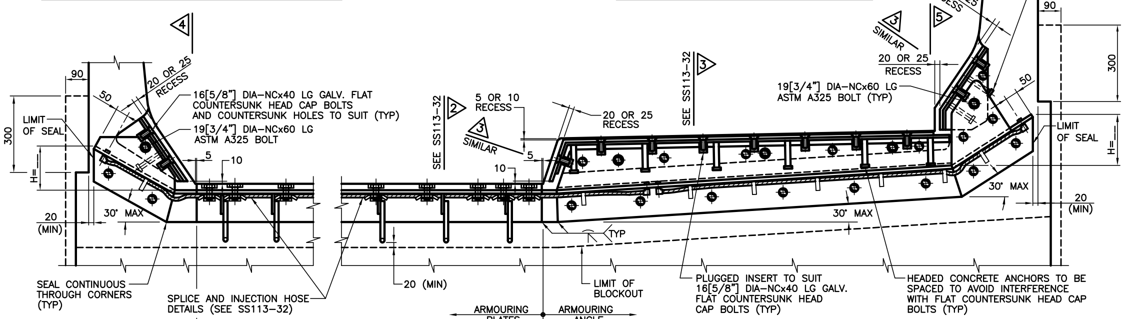
STANDARD DRAWING DECEMBER 2004	SS113-22
MODULAR EXPANSION JOINT WITH INJECTION HOSE SYSTEM – DETAILS II	

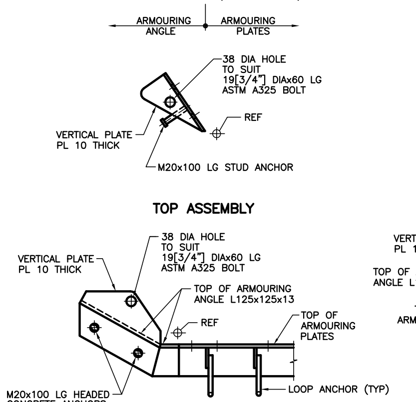
REVISIONS			DESCRIPTION	
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG



PLAN OF JOINT AT BARRIER WALL

PLAN OF JOINT AT SIDEWALK

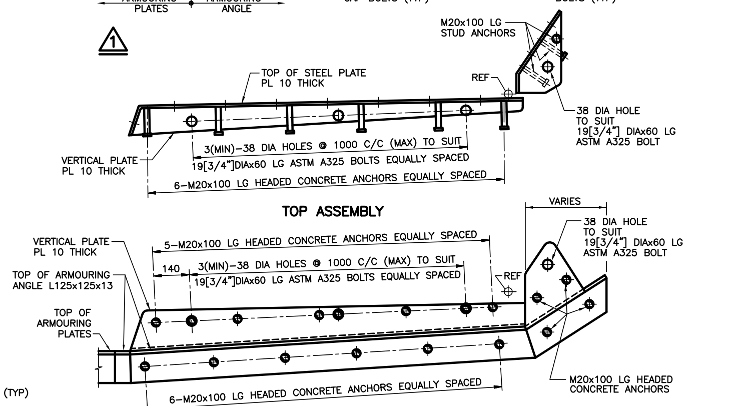




TOP ASSEMBLY

BOTTOM ASSEMBLY

DETAILS OF ARMOURING WITHOUT SIDEWALK



TOP ASSEMBLY

BOTTOM ASSEMBLY

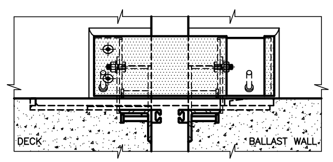
DETAILS OF ARMOURING AT SIDEWALK

NOTES TO DESIGNER:

1. THIS SLIDING PLATE EXPANSION JOINT SHALL BE USED ONLY FOR MOVEMENTS FROM 76mm TO 120mm.
2. SLIDING PLATE EXPANSION JOINTS SHALL ONLY BE USED AT ABUTMENTS OF POST-TENSIONED BRIDGES, AND AT ABUTMENTS OF GIRDER-TYPE BRIDGES WHERE THE DIAPHRAGMS ARE INTEGRAL WITH THE DECK. THEY SHALL NOT BE USED AT PIERS.
3. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWINGS SS113-31 AND SS113-14, INSTEAD OF THIS STANDARD DRAWING.
4. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
5. WHEN THE SKEW IS GREATER THAN 5° AND THE REQUIRED HEIGHT OF ARMOURING UPTURN 'H' (SEE NOTE 5) EQUALS 180mm, THE WIDTH OF DECK SHALL BE WIDENED LOCALLY BY 40mm BEYOND THE STANDARD 50mm PROJECTION. THIS LOCAL WIDENING SHALL TYPICALLY EXTEND VERTICALLY TO 300mm ABOVE TOP OF CONCRETE PROJECTION, AND LONGITUDINALLY TO THE LIMITS OF BLOCKOUT IN BARRIER WALL (SEE DASHED LIMITS ON PLAN AND SECTIONS). THIS DETAIL SHALL ALSO BE SHOWN ON THE DECK, BARRIER WALL AND ABUTMENT DRAWINGS.
6. REQUIRED HEIGHT OF UPTURN (H):

	CROSSFALL SLOPE	DECK WITH CROWN		DECK WITHOUT CROWN	
WITHOUT SIDEWALK	≤ 2%	100	100	100	0
	> 2%	180	180	180	0
WITH SIDEWALK	> 0%	100	100	100	100

7. WHEN THE CROSSFALL SLOPES AT THE TWO ABUTMENTS ARE NOT INDENTICAL, TWO VALUES OF 'H' SHALL BE GIVEN AT EACH SIDE OF THE DECK.
8. THE 'NOTES TO DESIGNER' MAY BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



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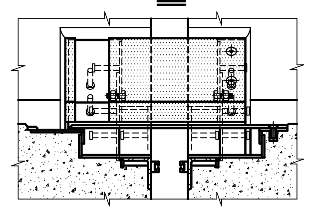


5

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS

NOTES:

1. EXPANSION JOINT SHALL BE TYPE 'C' AND SUPPLIED BY A MANUFACTURER LISTED IN THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.27, TYPE 'C'.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL SHALL BE ACCORDING TO OPSS 1210, EXCEPT THAT GRADE FOR SLIDING PLATE SHALL BE 350W.
4. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
5. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
6. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
7. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
8. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
9. SETTING CHANNELS SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
10. AFTER CURING THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING PLATES AND NOSING ANGLES SHALL THEN BE EPOXY INJECTED.
11. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
12. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH FOR PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
13. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
14. FOR POST-TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST-TENSIONING OPERATIONS.
15. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
16. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
17. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
18. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113-32 AND SS113-33.

ADDITIONAL NOTES FOR BOLTS:

1. 19 [3/4] DIAMETER BOLTS SHALL BE IN ACCORDANCE WITH WITH ASTM A325. ALL BOLTS USED IN 38 DIA. HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16 [5/8] DIA. COATED FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
4. ALL BOLTS SHALL BE TENSIONED USING THE TURN-OF-NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6-06.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

STANDARD DRAWING
AUGUST 2015

SS113-30

SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-06	LOAD	DATE
DRAWN	CHK	SITE	STRUCT	SCHEME	DWG

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

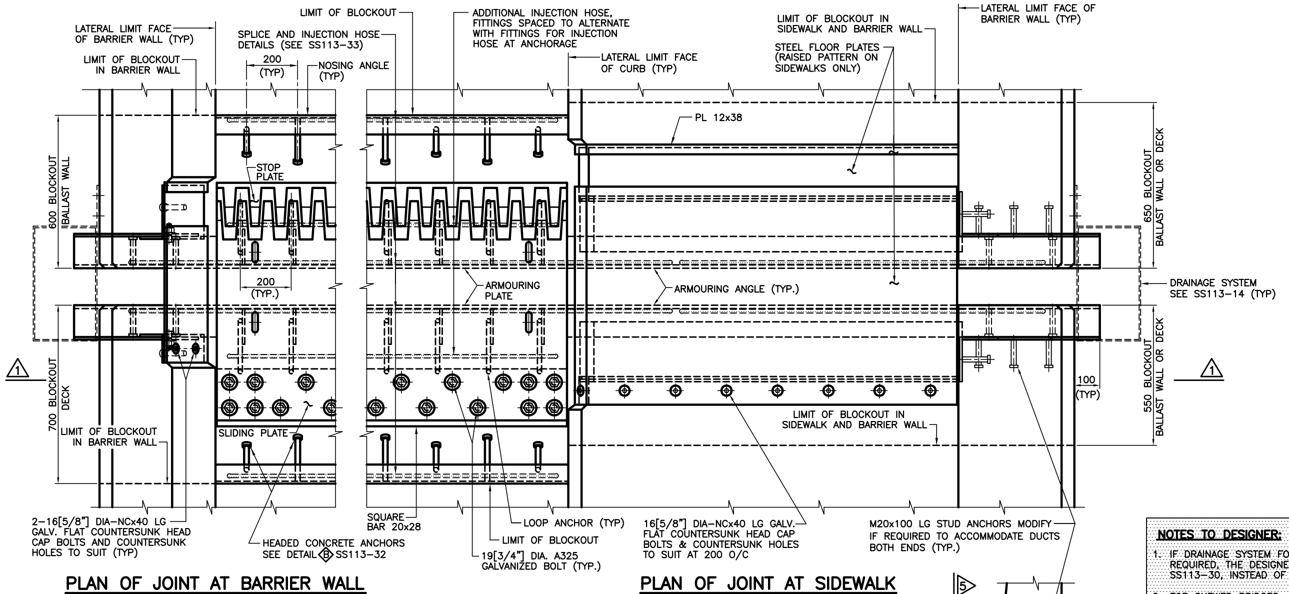
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

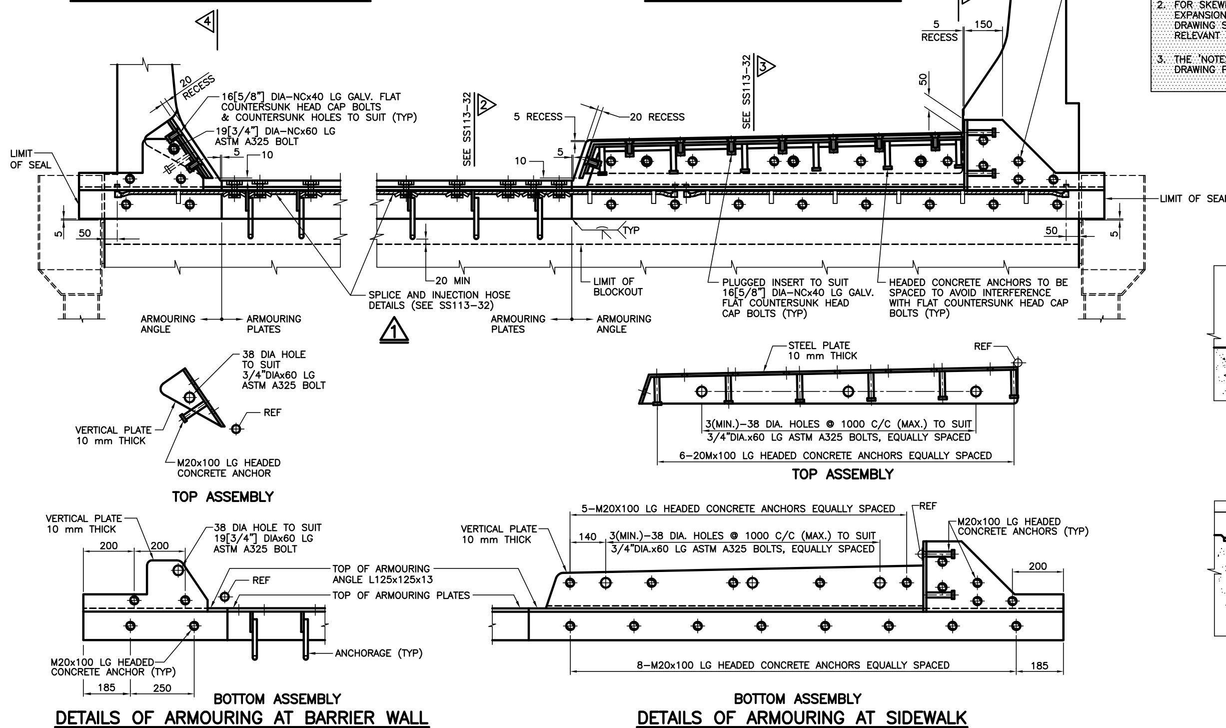
SHEET

SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS – WITH DRAINAGE SYSTEM



PLAN OF JOINT AT BARRIER WALL

PLAN OF JOINT AT SIDEWALK

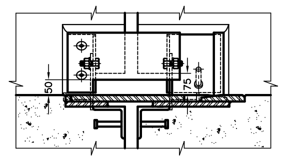


DETAILS OF ARMOURING AT BARRIER WALL

DETAILS OF ARMOURING AT SIDEWALK

NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINT IS NOT REQUIRED, THE DESIGNER SHOULD USE STANDARD DRAWING SS113–30, INSTEAD OF THIS STANDARD DRAWING.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. THE 'NOTES TO DESIGNER' MAY BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



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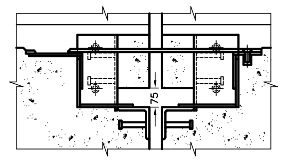

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DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

NOTES:

1. EXPANSION JOINT SHALL BE TYPE 'C' AND SUPPLIED BY A MANUFACTURER LISTED IN THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.27, TYPE "C".
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL SHALL BE ACCORDING TO OPSS 1210, EXCEPT THAT GRADE FOR SLIDING PLATE SHALL BE 350W.
4. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
5. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
6. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   – FOR CONCRETE STRUCTURES – 48 HOURS
   – FOR STEEL STRUCTURES – 24 HOURS
7. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
8. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
9. SETTING CHANNELS SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
10. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING PLATES AND NOSING ANGLES SHALL THEN BE EPOXY INJECTED.
11. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
12. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH FOR PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
13. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
14. FOR POST–TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST–TENSIONING OPERATIONS.
15. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
16. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
17. ALL JOINT ANCHORAGES SHALL BE DETAILED PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
18. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113–32, SS113–33 AND SS113–14.

ADDITIONAL NOTES:

1. 7/8" DIAMETER COATED FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
2. 3/4" DIAMETER COATED BOLTS SHALL BE IN ACCORDANCE WITH ASTM A325.
3. 5/8" DIAMETER COATED FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
4. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
5. ALL BOLTS SHALL BE TENSIONED USING THE TURN–OF–NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6–06.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

STANDARD DRAWING
AUGUST 2015

SS113–31

SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR BARRIER WALLS – WITH DRAINAGE SYSTEM

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC–06	CL 625–ONT	DATE
DRAWN	CHK	SITE		DWG

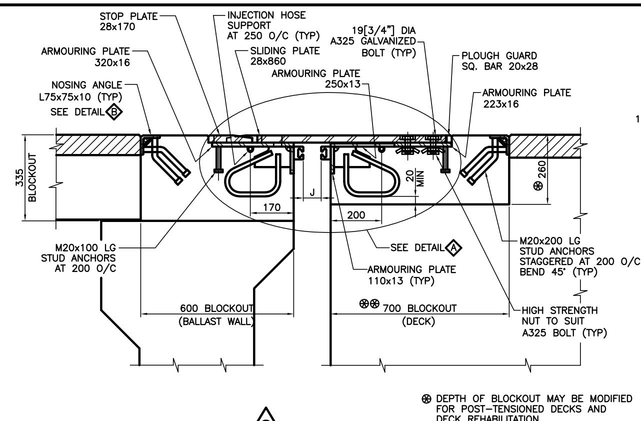
MINISTRY OF TRANSPORTATION, ONTARIO PH–D–707 88–05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

SLIDING PLATE EXPANSION JOINT DETAILS I



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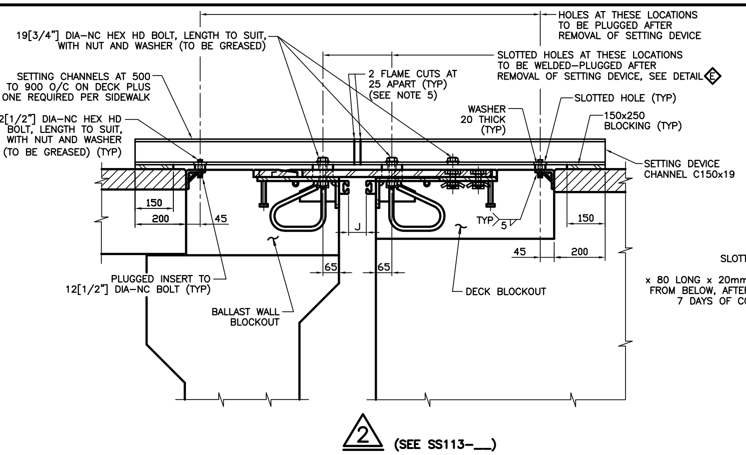
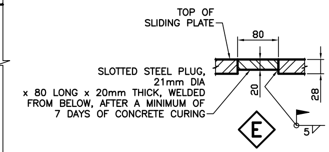


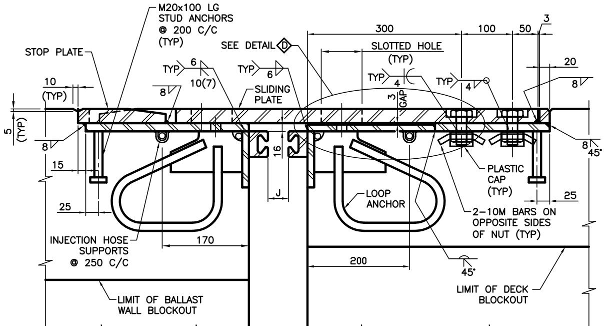
2 (SEE SS113-__)

SETTING DEVICE AND BLOCKOUTS



NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113-__ AND SS113-__.
2. LIFTING DETAILS FOR FULL EXPANSION JOINT ASSEMBLY TO BE SHOWN ON SHOP DRAWINGS.
3. SLIDING PLATES SHALL BE MAINTAINED INSTALLED DURING THE CASTING AND CURING OF THE CONCRETE IN THE EXPANSION JOINT BLOCKOUT.
4. ADEQUATE CLAMPING TO MAINTAIN THE VERTICAL ALIGNMENT OF THE SLIDING PLATES DURING THE JOINT ASSEMBLY INSTALLATION SHALL BE DETAILED ON THE SHOP DRAWINGS. THE DEVICE SHALL ALLOW FOR LONGITUDINAL MOVEMENT OF THE SLIDING PLATES.
5. SETTING CHANNELS TO BE FLAME CUT NOT LATER THAN 4 HOURS AFTER PLACING OF CONCRETE IN BLOCKOUTS. BOLTED BACK-TO-BACK SETTING CHANNELS WITH RELEASE SYSTEM MAY BE SUBSTITUTED.



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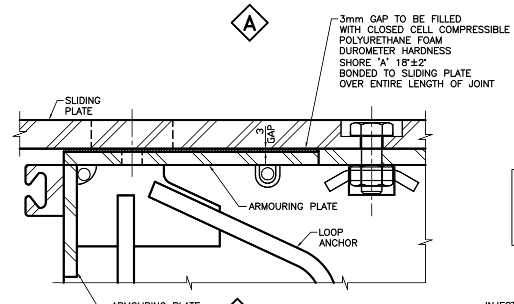

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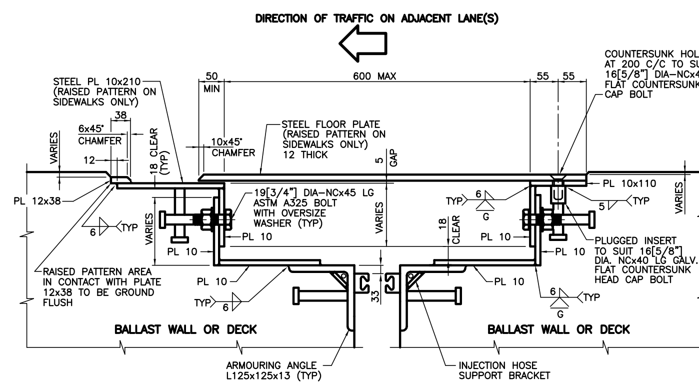
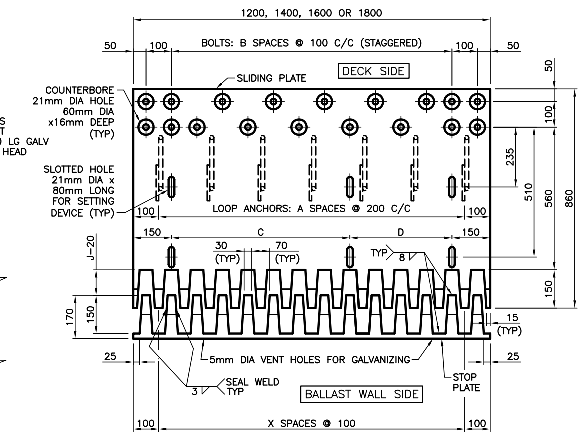


3 (SEE SS113-__)



TYPICAL SLIDING PLATE LAYOUT

SCALE 1:10

SLIDING PLATE LENGTH (mm)	X	A	B	C (mm)	D (mm)
1200	10	5	9	900	0
1400	12	6	11	500	600
1600	14	7	13	700	600
1800	16	8	15	700	800

TABLE OF DESIGN REQUIREMENTS

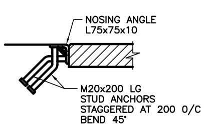
EXP JOINT LOCATION	MTO GAP ** RATING (mm)		DESIGN *** MOVEMENT	* "J" AT INSTALLATION TEMPERATURE(°C) (mm)							
	MIN	MAX		-5°	0°	5°	10°	15°	20°	25°	30°
	30	150									
	30	150									

* DIMENSION 'J' MEASURED PERPENDICULAR TO CENTRELINE EXPANSION JOINT. WHERE MIN. AND MAX. FOR JOINT SUPPLIED DIFFER FROM THOSE SHOWN IN TABLE, 'J' DIMENSIONS SHALL BE REVISED BY CONTRACTOR AND SHOWN ON SHOP DRAWINGS.

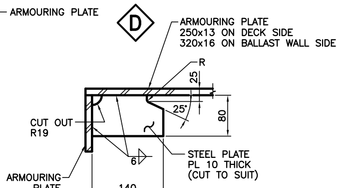
** MTO GAP MEASURED BETWEEN PROJECTING FACES OF STEEL RETAINERS. MTO GAP RATING SHALL BE AS GIVEN IN THE TABLE OF DESIGN REQUIREMENTS.

*** CALCULATED TOTAL MOVEMENT @ SLS OCCURRING AFTER TIME OF JOINT INSTALLATION. (MEASURED PARALLEL TO CENTRELINE OF STRUCTURE)

NOTE:
IF THE FOAM IS NOT PLACED IN SHOP, A 3mm THICK TEMPORARY SHIM TO BE ADDED FOR TRAVELLING. SHIM TO BE REMOVED AFTER CONCRETE IN BLOCKOUTS HAS BEEN CURED.



B



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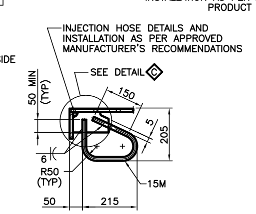
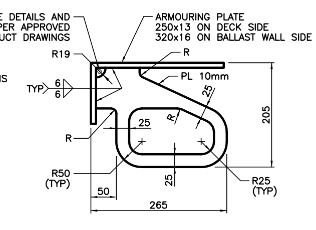
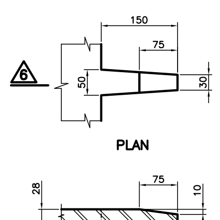


LOOP ANCHOR DETAIL

(FOR ALTERNATIVE SEE F)



F ALTERNATIVE ANCHORAGE DETAIL



6

TYPICAL FINGER CHAMFER

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
SEPTEMBER 2016

SS113-32

SLIDING PLATE EXPANSION JOINT DETAILS I

REVISIONS				DESCRIPTION	
DESIGN	CHK	CODE CHBDC-14	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No

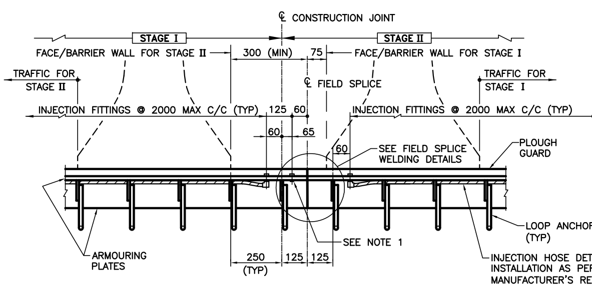
SHEET

SLIDING PLATE EXPANSION JOINT DETAILS II

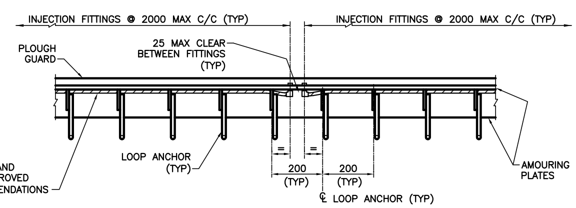
NOTES:

1. MIDDLE INJECTION FITTING AT FIELD SPLICE IS INSTALLED WITHOUT ELBOW AND HOSE.
2. PROTECT PRESSURE HOSE AND FITTINGS ADJACENT TO FIELD SPLICE DURING WELDING AND REMOVE PROTECTION PRIOR TO PLACING OF CONCRETE IN BLOCKOUT.

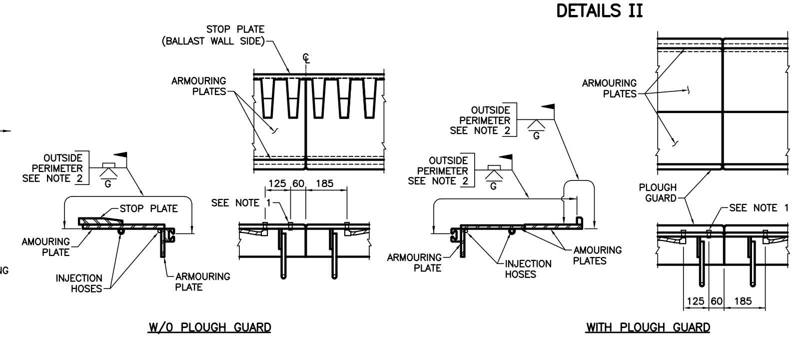
DETAILS II



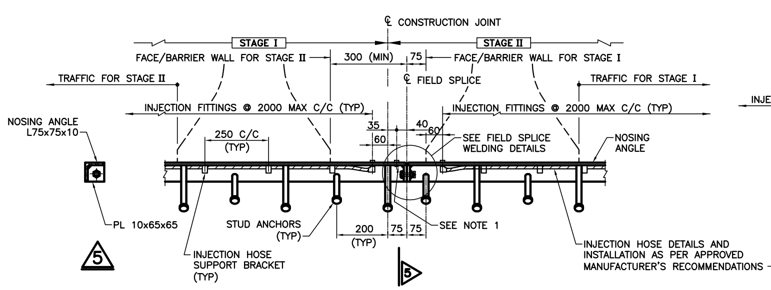
FIELD SPLICE DETAILS AT STAGED CONSTRUCTION FOR ARMOURING PLATES



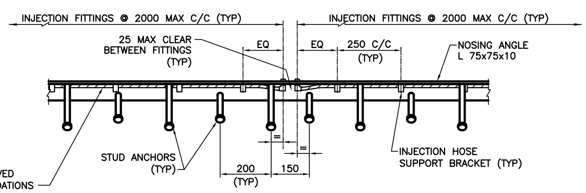
INJECTION HOSE DETAILS FOR AMOURING PLATES (WITHOUT FIELD SPLICE)



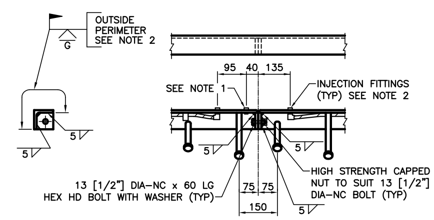
FIELD SPLICE WELDING DETAILS FOR ARMOURING PLATES



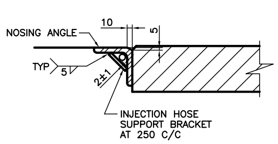
FIELD SPLICE DETAILS AT STAGED CONSTRUCTION FOR NOSING ANGLE



INJECTION HOSE DETAILS FOR NOSING ANGLE (WITHOUT FIELD SPLICE)



FIELD SPLICE WELDING DETAILS FOR NOSING ANGLE



INJECTION HOSE SUPPORT BRACKET DETAIL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
JAN 2013

SS113-33

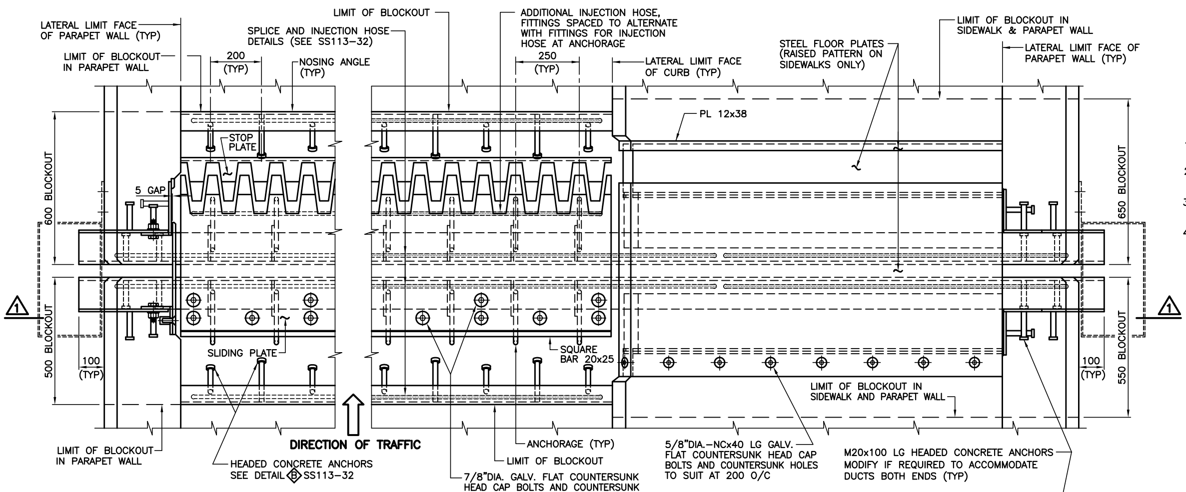
SLIDING PLATE EXPANSION JOINT DETAILS II

REVISIONS					
			DESCRIPTION		
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

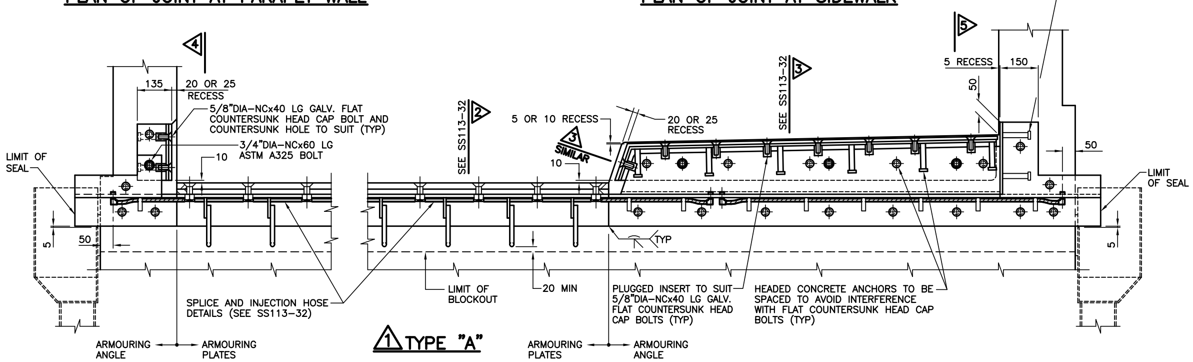
CONT No	
WP No	
SHEET	

SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS – WITH DRAINAGE SYSTEM



PLAN OF JOINT AT PARAPET WALL

PLAN OF JOINT AT SIDEWALK



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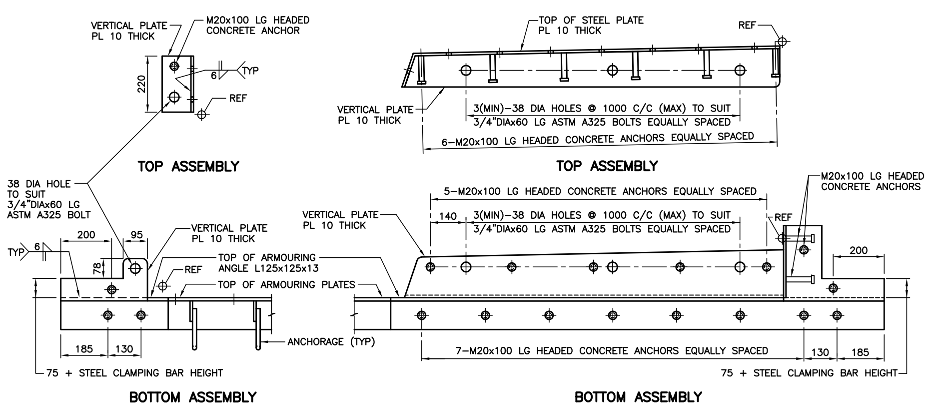
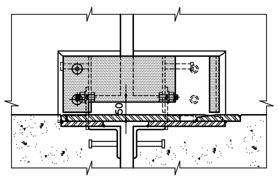


DETAILS OF ARMOURING WITHOUT SIDEWALK

DETAILS OF ARMOURING AT SIDEWALK



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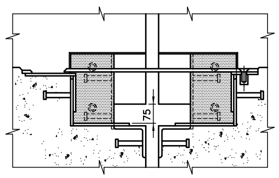


5

ADDITIONAL NOTES FOR BOLTS:

1. ALL BOLTS SHALL BE COATED WITH ZINC-PHOSPHATE OR HOT DIP GALVANIZED.
2. 7/8" DIAMETER COATED FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE TENSIONED TO 194kN AND BE IN ACCORDANCE WITH ASTM F835.
3. 3/4" DIAMETER COATED BOLTS SHALL BE TENSIONED TO 125kN AND BE IN ACCORDANCE WITH ASTM A325.
4. 5/8" DIAMETER COATED FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE TENSIONED TO 95kN AND BE IN ACCORDANCE WITH ASTM F835.

NOTES:

1. EXPANSION JOINT SHALL BE TYPE 'C' AND SUPPLIED BY A MANUFACTURER LISTED IN THE DESIGNATED SOURCES FOR MATERIAL; LIST DSM 9.40.27, TYPE 'C'.
2. FABRICATORS OF EXPANSION JOINT ASSEMBLIES SHALL BE CERTIFIED IN ACCORDANCE WITH CSA STANDARD W47.1-92, DIVISION 2.1.
3. STEEL SHALL BE GRADE 300W.
4. ALL COMPONENTS OF EXPANSION JOINT ASSEMBLY SHALL BE HOT-DIP GALVANIZED, AFTER COMPLETION OF FABRICATION. ALL DAMAGED GAVANIZED SURFACES SHALL BE COATED WITH TWO COATS OF ZINC RICH PAINT.
5. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
6. REINFORCING STEEL SHALL BE IN ACCORDANCE WITH STANDARD CAN/CSA-G30.18-M09 GRADE 400W.
7. HEADED CONCRETE ANCHORS SHALL BE IN ACCORDANCE WITH DSM 9.10.75 USING FUSION WELD PROCESS.
8. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
9. THE 'J' DIMENSIONS SHOWN ON SHOP DRAWINGS ARE TO BE USED FOR CONSTRUCTION.
10. JOINT ASSEMBLY SHALL BE INSTALLED TO MATCH ELEVATION AND GRADE OF CONCRETE END DAMS USING CONCRETE BLOCKOUT METHOD.
11. FINAL WIDTH ADJUSTMENT (DIM. 'J') SHALL BE MADE, AND SETTING DEVICES TIGHTENED JUST PRIOR TO PLACING 30 MPa CONCRETE IN BLOCKOUTS.
12. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
    - FOR CONCRETE STRUCTURES – 48 HOURS
    - FOR STEEL STRUCTURES – 24 HOURS
13. FIELD SPLICES IN ASSEMBLY ARE NOT PERMITTED, UNLESS SHOWN ON CONTRACT DRAWINGS.
14. ALL SPLICES TO BE SHOWN ON SHOP DRAWINGS. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SHOP-SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTERLINE OF THE TRAFFIC LANE.
15. UPTURN OF ARMOURING ANGLE (AND SEAL) AT PARAPET WALL IS NOT REQUIRED. PROFILE OF ARMOURING ANGLE SHALL BE PARALLEL TO DECK CROSSFALL (ALONG SKEW IF ANY).
16. SETTING CHANNELS TO BE FLAME CUT NOT LATER THAN 4 HOURS AFTER PLACING OF CONCRETE IN BLOCKOUTS. BOLTED BACK-TO-BACK SETTING CHANNELS WITH RELEASE SYSTEM MAY BE SUBSTITUTED.
17. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING SHALL BE PRESSURE INJECTED WITH AN INJECTION HOSE SYSTEM BY AN ACCEPTABLE SYSTEM IDENTIFIED IN DSM 9.40.18. INJECTION METHODS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS. CHECK FOR REMAINING VOIDS AND DRILL HOLES IN ARMOURING WHERE NECESSARY. THE SETTING CHANNEL BOLT HOLES SHALL BE DRILLED OUT TO A DEPTH OF 20mm AND THEN CLEANED OUT USING OIL-FREE AIR. INJECTION PORTS SHALL BE REMOVED AND ALL HOLES AND REMAINING VOIDS SHALL BE PRESSURE INJECTED WITH AN EPOXY AS USED IN DSM 9.40.18.
18. SEALS SHALL BE PREFORMED NEOPRENE SEALS IN ACCORDANCE WITH OPSS-1210 AND SHALL BE INSTALLED IN ONE CONTINUOUS PIECE. SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
19. ALL STEEL SURFACES IN CONTACT WITH NEOPRENE SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL AND PROTECTED DURING PLACING OF CONCRETE.
20. BOLT THREADS AND UNDERSIDE OF HEADS SHALL BE LIBERALLY COATED WITH ANTISEIZE COMPOUND MEETING U.S. MILITARY SPECIFICATION MIL-A-907D JUST PRIOR TO SEAL INSTALLATION.
21. SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE AND STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED AND EXPANSION GAP PROPERLY CLEARED.
22. FOR POST-TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST __ DAYS AFTER COMPLETION OF POST-TENSIONING OPERATIONS.
23. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. HEADED CONCRETE ANCHORS SHALL BE AT 200mm O/C.
24. FOR SKEWED STRUCTURE, DETAILS SHALL BE ADJUSTED TO SUIT GEOMETRY OF STRUCTURE.
25. THE ORIENTATION OF ARMOURING ANCHORAGE BARS AND HEADED CONCRETE ANCHORS FOR ALL STRUCTURES, WHETHER SQUARE OR SKEWED, SHALL BE PERPENDICULAR TO THE ARMOURING ANGLE, AT BOTH DECK AND ABUTMENT SIDES.
26. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113-32 AND SS113-14.

NOTES TO DESIGNER:

1. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS NOT REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWING SS113-33 INSTEAD OF THIS DRAWING.
2. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
3. THE 'NOTES TO DESIGNER' MAY BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING AUGUST 2015	SS113-34
SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS – WITH DRAINAGE SYSTEM	

REVISIONS		DESCRIPTION	
DESIGN	CHK	CODE CHBDC-06 CL 625-ONT	DATE
DRAWN	CHK	SITE	DWG

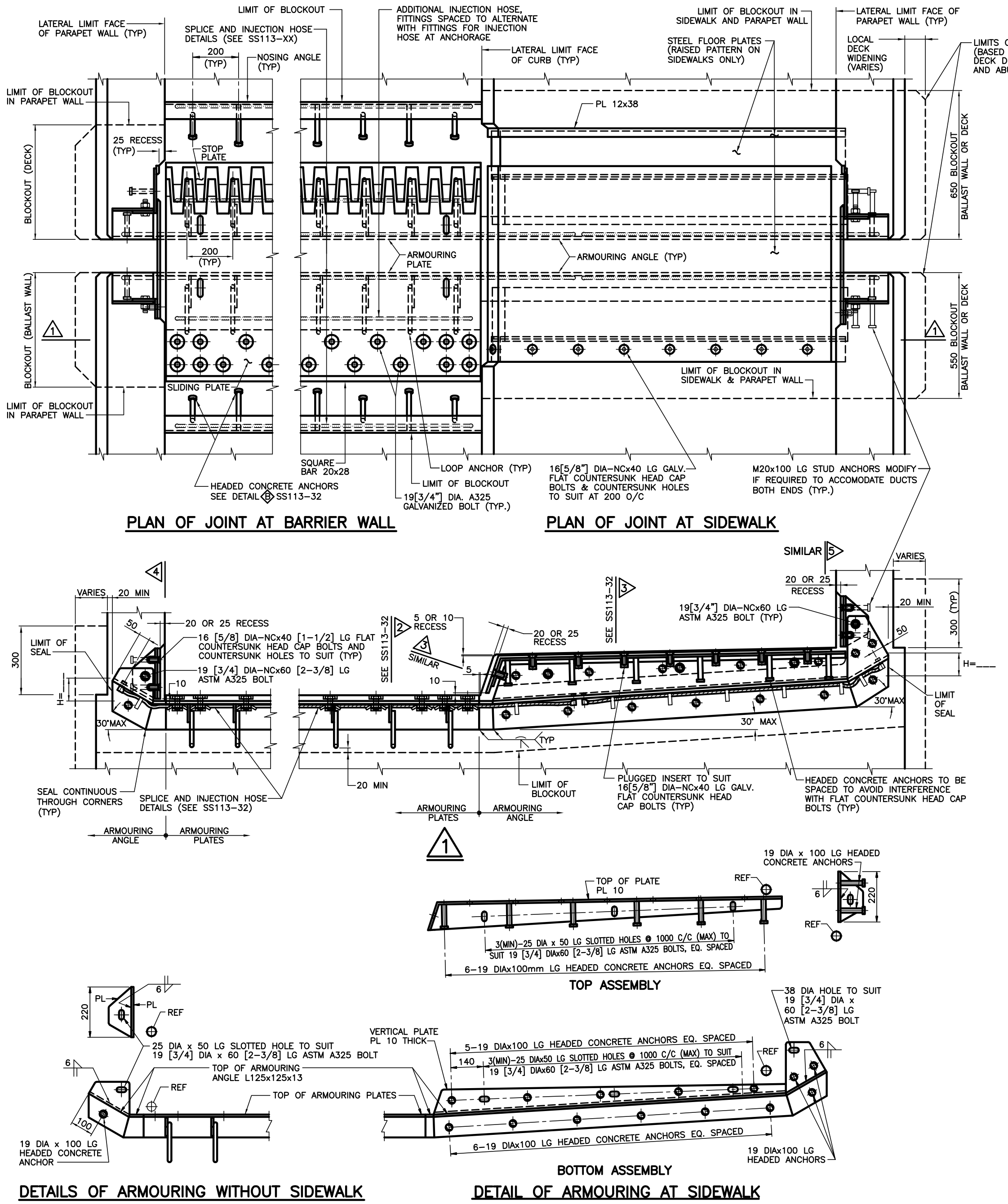
MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS



DETAILS OF ARMOURING WITHOUT SIDEWALK

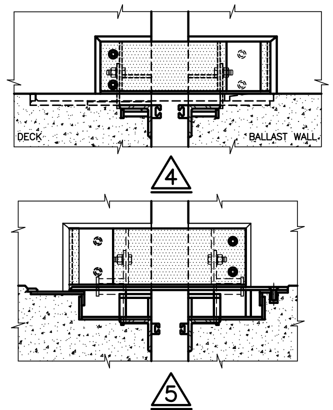
DETAIL OF ARMOURING AT SIDEWALK

NOTES TO DESIGNER:

1. SLIDING PLATE EXPANSION JOINTS SHALL ONLY BE USED AT ABUTMENTS OF POST-TENSIONED BRIDGES, AND AT ABUTMENTS OF GIRDER-TYPE BRIDGES WHERE THE DIAPHRAGMS ARE INTEGRAL WITH THE DECK. THEY SHALL NOT BE USED AT PIERS.
2. IF DRAINAGE SYSTEM FOR EXPANSION JOINTS IS REQUIRED, THE DESIGNER SHALL USE STANDARD DRAWINGS SS113-31 AND SS113-14, INSTEAD OF THIS STANDARD DRAWING.
3. FOR SKEWED BRIDGES, A PLAN AND PROFILE OF THE EXPANSION JOINT(S) SHALL BE DETAILED ON THIS DRAWING SHOWING CROSSFALLS, BREAKPOINTS AND RELEVANT DIMENSIONS.
4. WHEN THE SKEW IS GREATER THAN 5° AND THE REQUIRED HEIGHT OF ARMOURING UPTURN 'H' (SEE NOTE 5) EQUALS 180mm, THE WIDTH OF DECK SHALL BE WIDENED LOCALLY BY 40mm BEYOND THE STANDARD 50mm PROJECTION. THIS LOCAL WIDENING SHALL TYPICALLY EXTEND VERTICALLY TO 300mm ABOVE TOP OF CONCRETE PROJECTION, AND LONGITUDINALLY TO THE LIMITS OF BLOCKOUT IN BARRIER WALL (SEE DASHED LIMITS ON PLAN AND SECTIONS). THIS DETAIL SHALL ALSO BE SHOWN ON THE DECK, BARRIER WALL AND ABUTMENT DRAWINGS.
5. REQUIRED HEIGHT OF UPTURN (H):

	CROSSFALL SLOPE	DECK WITH CROWN		DECK WITHOUT CROWN	
WITHOUT SIDEWALK	≤ 2%	100	100	100	0
	> 2%	180	180	180	0
WITH SIDEWALK	> 0%	100	100	100	100

6. WHEN THE CROSSFALL SLOPES AT THE TWO ABUTMENTS ARE NOT INDENTICAL, TWO VALUES OF 'H' SHALL BE GIVEN AT EACH SIDE OF THE DECK.
7. THE 'NOTES TO DESIGNER' MAY BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF CONTRACT.



NOTES:

1. EXPANSION JOINT SHALL BE TYPE 'C' AND SUPPLIED BY A MANUFACTURER LISTED IN THE DESIGNATED SOURCES FOR MATERIAL; LIST DSM 9.40.27, TYPE 'C'.
2. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
3. STEEL SHALL BE ACCORDING TO OPSS 1210, EXCEPT THAT GRADE FOR SLIDING PLATE SHALL BE 350W.
4. STEEL PLATE 10mm THICK UNLESS OTHERWISE NOTED.
5. JOINT ASSEMBLIES SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
6. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
7. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
8. IF THE JOINT ARMOURING FOR A SKEWED STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
9. SETTING CHANNELS SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
10. AFTER CURING THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING PLATES AND NOSING ANGLES SHALL THEN BE EPOXY INJECTED.
11. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
12. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
13. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST IN PLACE, STYROFOAM OR FILLER BETWEEN DECK AND BALLAST WALL REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
14. FOR POST-TENSIONED CONCRETE BRIDGES, JOINT ASSEMBLY SHALL NOT BE INSTALLED UNTIL AT LEAST ___ DAYS AFTER COMPLETION OF POST-TENSIONING OPERATIONS.
15. RAISED MEDIANS ON STRUCTURES SHALL BE PROVIDED WITH SLIDING PLATES. PLATE THICKNESS AND ANCHORAGES SHALL CONFORM TO SIDEWALK DETAILS, AND SHALL ACCOMMODATE INSTALLATION OF SEALS.
16. FOR SKEWED STRUCTURE, WORKING DRAWINGS SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
17. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE DECK SIDE AND THE ABUTMENT SIDE EXCEPT AS FOLLOWS. STRUCTURES SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE DECK SIDE.
18. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS SS113-32 AND SS113-33.

ADDITIONAL NOTES FOR BOLTS:

1. 19[3/4"] DIA COATED BOLTS SHALL BE IN ACCORDANCE WITH ASTM A325. ALL BOLTS USED IN 38 mm DIA. HOLES SHALL BE INSTALLED WITH OVERSIZE WASHERS.
2. 16[5/8"] DIA COATED FLAT COUNTERSUNK HEAD CAP BOLTS SHALL BE IN ACCORDANCE WITH ASTM F835.
3. ALL BOLTS SHALL BE INSTALLED USING MOLY50 LUBRICANT.
4. ALL BOLTS SHALL BE TENSIONED USING THE TURN-OF-NUT TIGHTENING METHOD IN ACCORDANCE WITH CAN/CSA S6-06.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

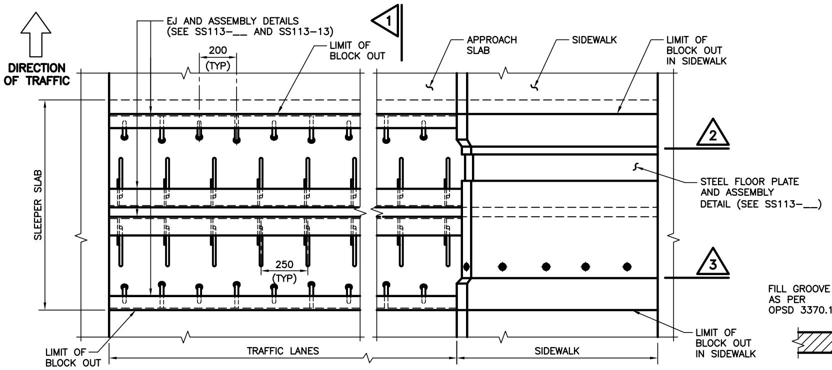
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING AUGUST 2015 — SS113-35

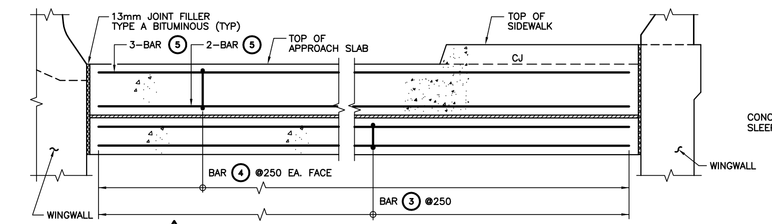
SLIDING PLATE EXPANSION JOINT ASSEMBLY FOR PARAPET WALLS

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-06	CL 625-ONT	DATE
DRAWN	CHK	SITE		DWG

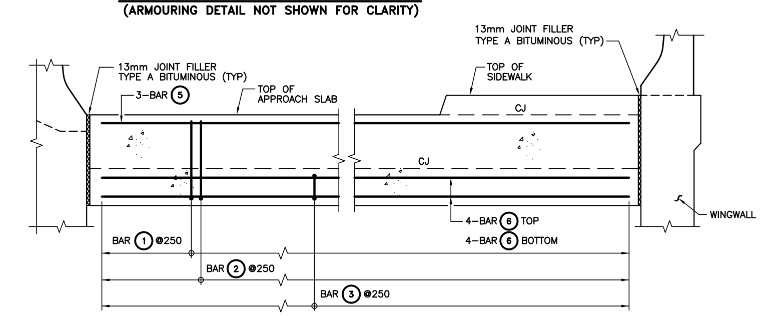
DIRECTION OF TRAFFIC



PLAN OF JOINT



2 **SECTION AT WINGWALL**
(ARMOURING DETAIL NOT SHOWN FOR CLARITY)



3 **SECTION AT WINGWALL**
(ARMOURING DETAIL NOT SHOWN FOR CLARITY)

TABLE OF DESIGN REQUIREMENTS (TO BE FULLY COMPLETED BY DESIGNER)

EXP. JOINT LOCATION	MTO GAP ** RATING (mm)		DESIGN *** MOVEMENT	* "J" AT INSTALLATION TEMPERATURE (C) (mm)							
	MIN	MAX		-5°	0°	5°	10°	15°	20°	25°	30°

* DIMENSION 'J' MEASURED PERPENDICULAR TO CENTRELINE OF EXPANSION JOINT. WHERE MIN. AND MAX. FOR JOINT SUPPLIED DIFFER FROM THOSE SHOWN IN TABLE, 'J' DIMENSIONS SHALL BE REVISED BY CONTRACTOR AND SHOWN ON SHOP DRAWINGS. FOR STAGED CONSTRUCTION ON STRUCTURES OTHER THAN POST-TENSIONED, THE CONTRACTOR SHALL USE THE FIRST STAGE OBSERVED 'J' GAP TO INSTALL THE SECOND STAGE.

** MTO GAP, MEASURED BETWEEN PROJECTING FACES OF STEEL CLAMPING BAR, IS TAKEN FROM DSM 9.40.27, TYPE "C".

*** CALCULATED TOTAL MOVEMENT AT SLS OCCURRING AFTER TIME OF JOINT INSTALLATION. (MEASURED PARALLEL TO CENTRELINE OF STRUCTURE)

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

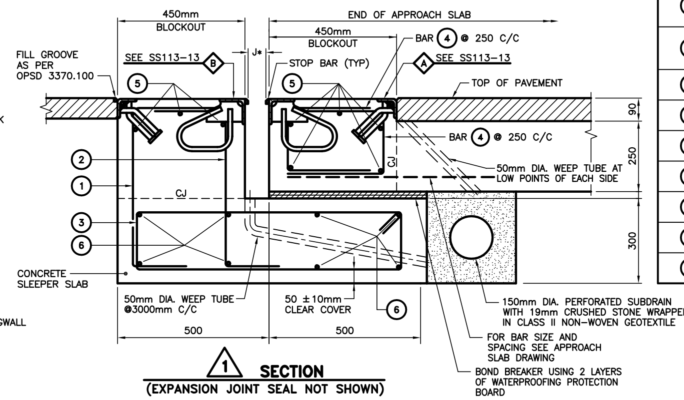
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

CONT No
WP No

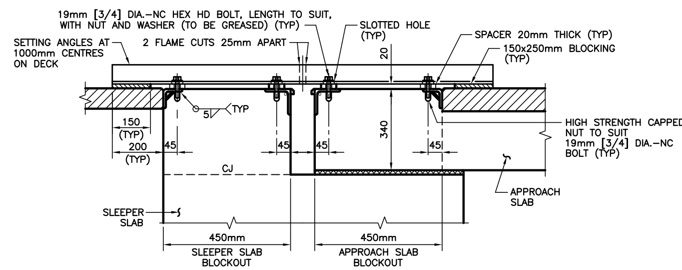
EXPANSION JOINT AND SLEEPER SLAB FOR INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES (MOVEMENT > 40mm)

SHEET

BAR MARK	SIZE	SHAPE
1	S15M	310 / 520 / 180
2	S15M	300 / 520 / 180
3	15M	160 / 860
4	S15M	200 / 310
5	S15M	STRAIGHT
6	15M	STRAIGHT
7	S15M	180 / 445
8	S15M	STRAIGHT
9	S15M	180 / 670



1 **SECTION**
(EXPANSION JOINT SEAL NOT SHOWN)



SETTING DEVICE AND BLOCKOUTS

NOTES:

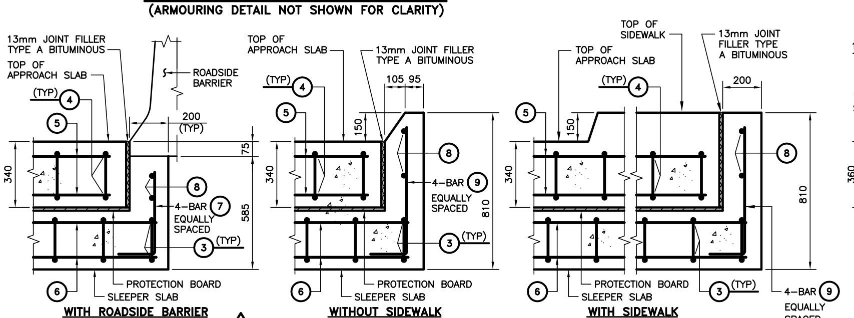
1. THIS DRAWING SHOWS EXPANSION JOINT AND SLEEPER SLAB AT THE END OF APPROACH SLAB OF INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES AND THIS DETAIL IS ONLY APPLICABLE FOR CONCRETE BRIDGES GREATER THAN 100m IN LENGTH AND STEEL BRIDGES GREATER THAN 75m IN LENGTH.
2. CLASS OF CONCRETE TO BE 30MPa.
3. REINFORCEMENT STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA. BARS MARKED WITH PREFIX S DENOTE STAINLESS STEEL BARS.
4. COVER TO REINFORCING STEEL 70 ±20mm EXCEPT AS NOTED.
5. EXPANSION JOINT SHALL BE IN ACCORDANCE WITH THE DESIGNATED SOURCES FOR MATERIALS LIST DSM 9.40.27, TYPE C.
6. EXPANSION JOINT ASSEMBLY CONSTRUCTION AND MATERIAL SHALL BE ACCORDING TO OPSS 920 AND OPSS 1210, AND AS SPECIFIED IN THE CONTRACT DOCUMENTS.
7. JOINT ASSEMBLY SHALL BE COMPLETELY SHOP ASSEMBLED (EXCEPT FOR SEALS) AND PRESET TO DIMENSION 'J' FOR 15°C AND ADJUSTED IN THE FIELD TO SUIT INSTALLATION TEMPERATURE.
8. JOINT ASSEMBLY INSTALLATION TEMPERATURE SHALL BE TAKEN AS MEAN SHADE AIR TEMPERATURE AT STRUCTURE PRIOR TO JOINT INSTALLATION AS FOLLOWS:
   - FOR CONCRETE STRUCTURES – 48 HOURS
   - FOR STEEL STRUCTURES – 24 HOURS
9. FIELD SPLICES IN JOINT ASSEMBLY ARE ONLY PERMITTED AT STAGED CONSTRUCTION, AND/OR AS SHOWN ON THE CONTRACT DRAWINGS.
10. FIELD SPLICE DETAILS AT STAGED CONSTRUCTION FOR ARMOURING PLATES AND NOSING ANGLES SHALL REFER TO DRAWING SS113-13.
11. IF THE JOINT ARMOURING FOR A SKEW STRUCTURE IS SPLICED AT A CROWN, THE SPLICE SHALL BE DETAILED PARALLEL TO THE CENTRELINE OF THE TRAFFIC LANE.
12. SETTING ANGLES SHALL BE FLAME CUT ACCORDING TO OPSS 920, BUT IN NO CASE PRIOR TO CONCRETE REACHING INITIAL SET.
13. AFTER CURING OF THE CONCRETE HAS BEEN COMPLETED, THE SETTING DEVICES MAY BE REMOVED. THE VOIDS UNDER THE ARMOURING ANGLE AND NOSING ANGLE SHALL THEN BE PRESSURE INJECTED.
14. PREFORMED SEALS SHALL HAVE MINIMUM THICKNESS OF 5mm OR AS PER DSM.
15. ALL STEEL RETAINER SURFACES COMING IN CONTACT WITH PREFORMED SEAL SHALL BE CLEANED PRIOR TO INSTALLATION OF THE SEAL.
16. PREFORMED SEALS SHALL BE INSTALLED AFTER JOINT ASSEMBLY HAS BEEN CAST, STYROFOAM OR FILLER BETWEEN APPROACH SLAB AND SLEEPER SLAB REMOVED, AND EXPANSION GAP CLEARED OF ANY DEBRIS.
17. HEADED CONCRETE ANCHORS IN NOSING ANGLES SHALL BE LOCATED WITHIN 75mm OF EITHER SIDE OF FIELD SPLICES.
18. PROTECT INJECTION HOSE AND FITTINGS ADJACENT TO FIELD SPLICE DURING WELDING AND REMOVE PROTECTION PRIOR TO PLACING OF CONCRETE IN BLOCKOUT.
19. FOR SKEWED STRUCTURE, WORKING DRAWING SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.
20. ALL JOINT ANCHORAGES SHALL BE DETAILED ON WORKING DRAWINGS PERPENDICULAR TO THE EXPANSION JOINT ON BOTH THE APPROACH SLAB SIDE AND THE SLEEPER SLAB SIDE EXCEPT STRUCTURE SKEWED FROM OVER 15° AND UP TO 45° SHALL HAVE ANCHORAGES DETAILED 30° OFFSET FROM THE PERPENDICULAR TO THE EXPANSION JOINT ON THE APPROACH SLAB SIDE.

LEGEND:

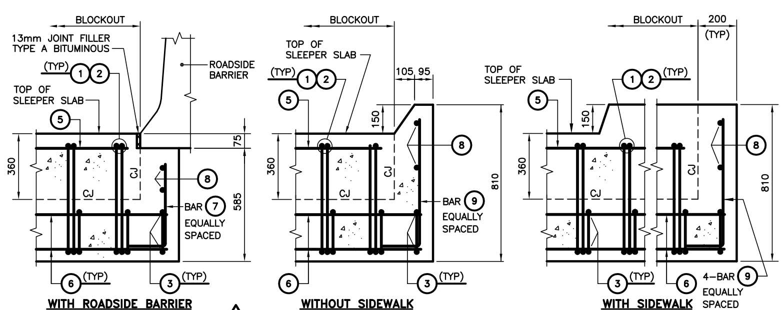
[ ] DENOTED FASTENER SIZE IN INCHES
CJ DENOTED CONSTRUCTION JOINT

NOTES TO DESIGNER

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ABUTMENTS DRAWING AND OPSD 3101.150. THE DESIGNER SHALL CHECK AND MODIFY THIS STANDARD DRAWING IF NECESSARY TO ENSURE THAT THE SLEEPER SLAB SITS ON GRANULAR MATERIAL THAT EXTENDS DOWN TO THE FROST PROTECTION DEPTH.
2. SUBDRAIN SHALL BE SHOWN ON THE GENERAL ARRANGEMENT DRAWING. WINGWALL SLEEVE DETAIL (OPSD 3102.100) SHALL BE REFERENCED WHERE APPLICABLE.
3. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



2 **SECTION BEYOND WINGWALL**



3 **SECTION BEYOND WINGWALL**

STANDARD DRAWING
SEPTEMBER 2016

SS113-36

EXPANSION JOINT AND SLEEPER SLAB FOR INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES (MOVEMENT > 40mm)

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-14	CL 625-ON	DATE
DRAWN	CHK	SITE		DWG

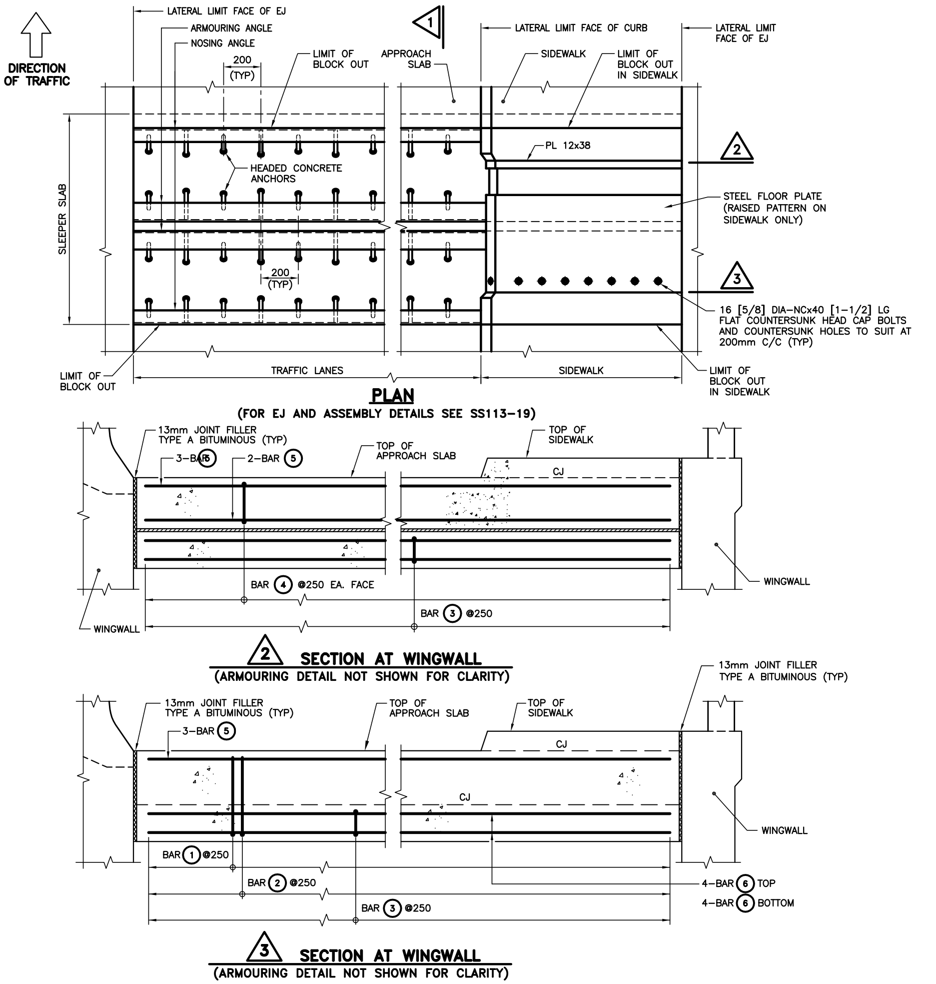
MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

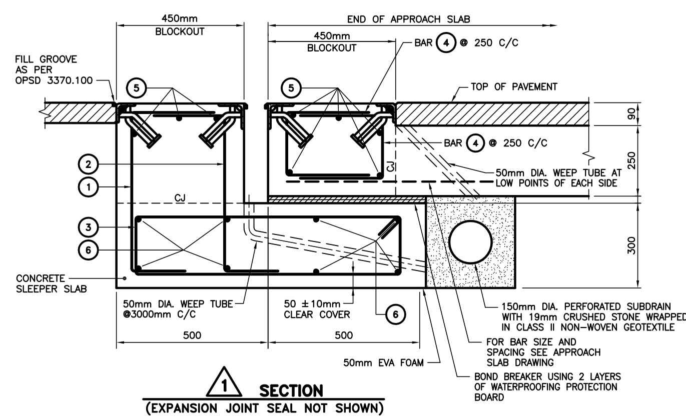
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

EXPANSION JOINT AND SLEEPER SLAB FOR INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES (10mm< MOVEMENT <40mm)

SHEET





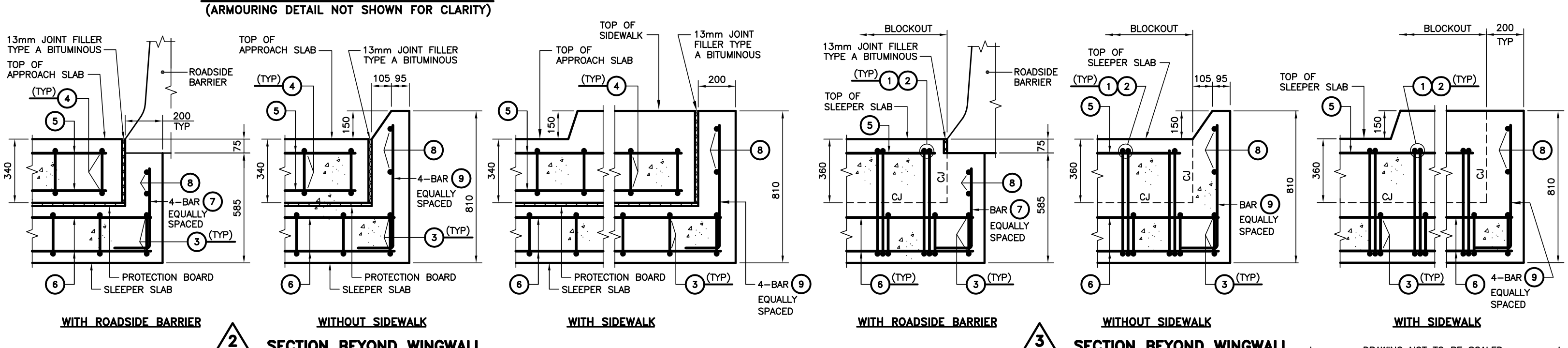
NOTES:

1. THIS DRAWING TO BE READ IN CONJUCTION WITH DRAWING SS113-19.
2. CLASS OF CONCRETE TO BE 30MPa.
3. REINFORCEMENT STEEL SHALL BE GRADE 400W. STAINLESS STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA. BARS MARKED WITH PREFIX S DENOTE STAINLESS STEEL BARS.
4. COVER TO REINFORCING STEEL 70 ±20mm EXCEPT AS NOTED.
5. FOR SKEWED STRUCTURE, WORKING DRAWING SHALL BE DETAILED TO SUIT GEOMETRY OF STRUCTURE.

LEGEND:

[ ] – DENOTED FASTENER SIZE IN INCHES
EJ – DENOTED EXPANSION JOINT
CJ – DENOTED CONSTRUCTION JOINT

BAR MARK	SIZE	SHAPE
1	S15M	310 / 520 / 180
2	S15M	300 / 520 / 180
3	15M	160 / 860
4	S15M	200 / 310
5	S15M	STRAIGHT
6	15M	STRAIGHT
7	S15M	180 / 445
8	S15M	STRAIGHT
9	S15M	180 / 670



NOTES TO DESIGNER

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ABUTMENTS DRAWING AND OPSD 3101.150. THE DESIGNER SHALL CHECK AND MODIFY THIS STANDARD DRAWING IF NECESSARY TO ENSURE THAT THE SLEEPER SLAB SITS ON GRANULAR MATERIAL THAT EXTENDS DOWN TO THE FROST PROTECTION DEPTH.
2. SUBDRAIN SHALL BE SHOWN ON THE GENERAL ARRANGEMENT DRAWING. WINGWALL SLEEVE DETAIL (OPSD 3102.100) SHALL BE REFERENCED WHERE APPLICABLE.
3. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

STANDARD DRAWING
SEPTEMBER 2016

SS113-37

EXPANSION JOINT AND SLEEPER SLAB FOR INTEGRAL AND SEMI-INTEGRAL ABUTMENT BRIDGES (10mm< MOVEMENT <40mm)

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION			
DESIGN	CHK	CODE CHBDC-14	CL 625-ON	DATE
DRAWN	CHK	SITE		DWG

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No WP No	
RIGID FRAME OPEN FOOTING CULVERT	SHEET

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

GENERAL NOTES:

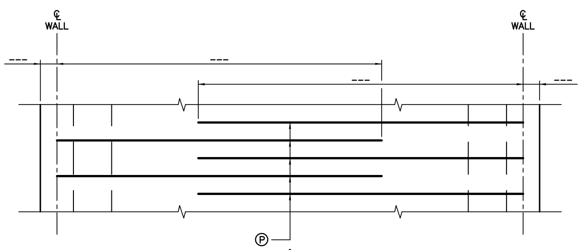
1. CLASS OF CONCRETE TO BE 30MPa
2. CLEAR COVER TO REINFORCING STEEL
   BOTTOM OF TOP SLAB 40± 10 FOR SLABS ≤ 300 THICK
   50± 10 FOR SLABS > 300 THICK
   BOTTOM OF FOOTINGS 100 ± 25
   REMAINDER 60 ± 20 UNLESS OTHERWISE NOTED
3. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
4. LEGEND
   ALT DENOTES ALTERNATE
   IF DENOTES INSIDE FACE
   OF DENOTES OUTSIDE FACE
   EF DENOTES EACH FACE

CONSTRUCTION NOTES:

1. BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
2. SIDES OF FOOTING TO BE CAST AGAINST UNDISTURBED SOIL.
3. SUPPORTS FOR REINFORCING STEEL SHALL BE AS PER OPSD-3329.101 AND OPSD-3329.100 ON FORMED SURFACES. ON NON-FORMED SURFACES, CONCRETE BLOCKS (MIN. 20MPa) SHALL BE USED.

QUANTITIES

ITEM	WALLS & SLABS	FOOTINGS	RETAINING WALL	TOTAL
VOLUME OF CONCRETE cubic metres	___	___	___	___



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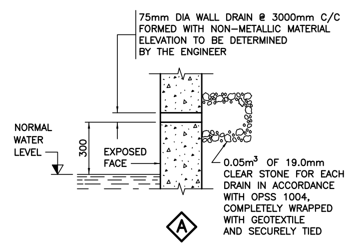

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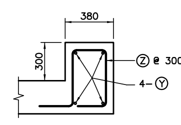


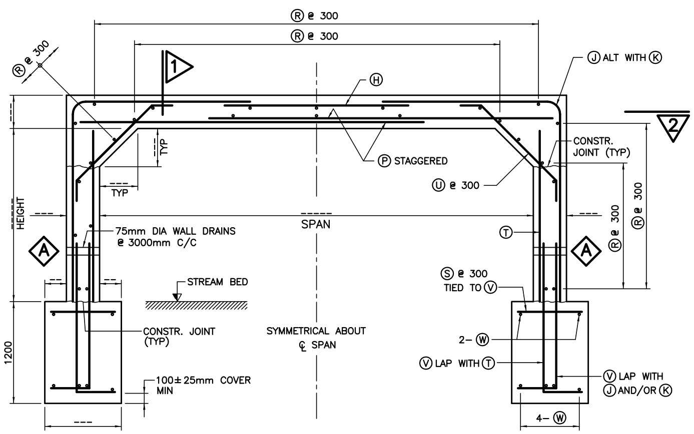
B

HEADER WALL

(WHERE REQUIRED)

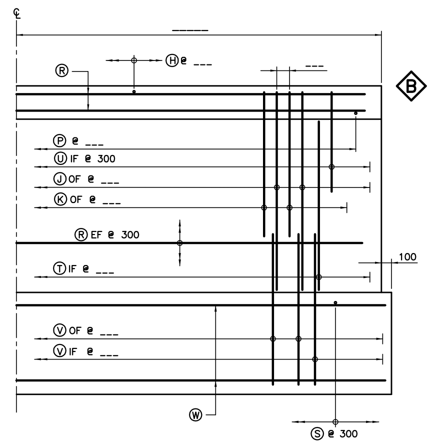
MARK	BAR SIZE	C/C	DETAILS	REMARKS
H	15M	___	STRAIGHT	TOP OF TOP SLAB
J	__M	___	R=___	J BARS ALTERNATE WITH K BARS
K	__M	___	R=___	K BARS ALTERNATE WITH J BARS
P *	__M	___	STRAIGHT	BOTTOM OF TOP SLAB STAGGERED
R	15M	300	STRAIGHT	LONGITUDINAL MIN. LAP SPLICE = 500
S	15M	300	STRAIGHT	TOP OF FOOTING
T	__M	___	STRAIGHT	INSIDE FACE OF WALLS
U	15M	300	45° 45° 180 180	HAUNCH
V	20M	___	1780 *	FOOTING DOWELS
W	20M	___	STRAIGHT	LONGITUDINAL IN FOOTING MIN. LAP SPLICE = 600
Y	__M	-	STRAIGHT	HEADER WALL
Z	15M	300	225 190 230	HEADER WALL

NOTES: – All dimensions shown to centre line of bar
– * represents vertical dimension
– ** c/c spacing given at midspan



TYPICAL CULVERT SECTION

(HEADER WALL DETAILS SHOWN IN B)



1

REFER TO 4.3.1 IN THE CCD MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

OPSD 3941.200 FIGURES IN CONCRETE SITE NUMBER AND DATE LAYOUT
OPSD 803.010 BACKFILL AND COVER FOR CONCRETE CULVERTS

STANDARD DRAWING APRIL 2011	SS114-1
RIGID FRAME OPEN FOOTING CULVERT	

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		DESCRIPTION			
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

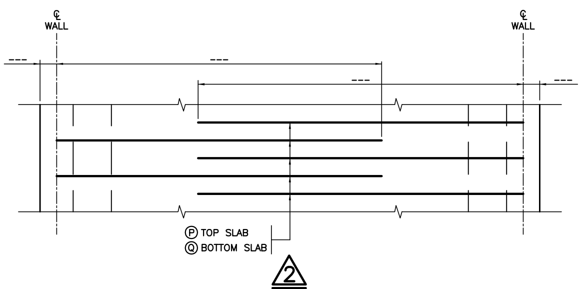
CONT No	SHEET
WP No	
RIGID FRAME BOX CULVERT	

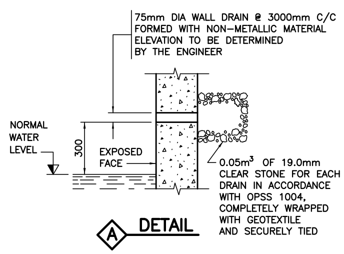
GENERAL NOTES:

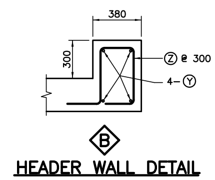
1 CLASS OF CONCRETE TO BE 30MPa
2 CLEAR COVER TO REINFORCING STEEL
   BOTTOM OF TOP SLAB 40 ± 10 FOR SLABS ≤ 300 THICK
   50 ± 10 FOR SLABS > 300 THICK
   BOTTOM OF BOTTOM SLAB 100 ± 25
   REMAINDER 60 ± 20 UNLESS OTHERWISE NOTED
3 REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
4 LEGEND
   ALT DENOTES ALTERNATE   OF DENOTES OUTSIDE FACE
   IF DENOTES INSIDE FACE   EF DENOTES EACH FACE

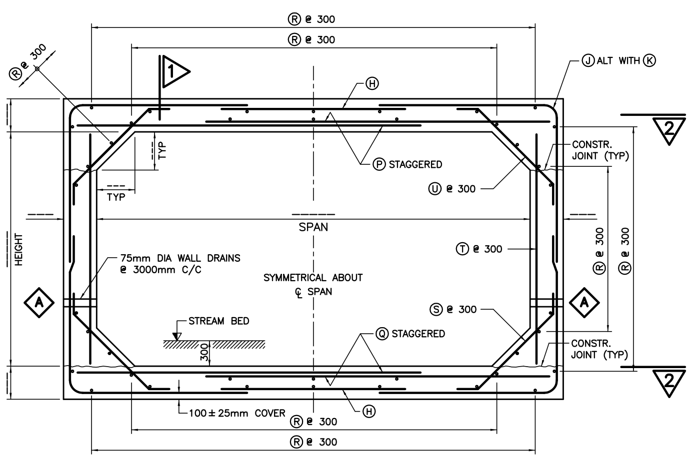
CONSTRUCTION NOTES:

1 BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
2 SUPPORTS FOR REINFORCING STEEL SHALL BE AS PER OPSD-3329.101 AND OPSD-3329.100 ON FORMED SURFACES. ON NON-FORMED SURFACES, CONCRETE BLOCKS (MIN. 20MPa) SHALL BE USED.



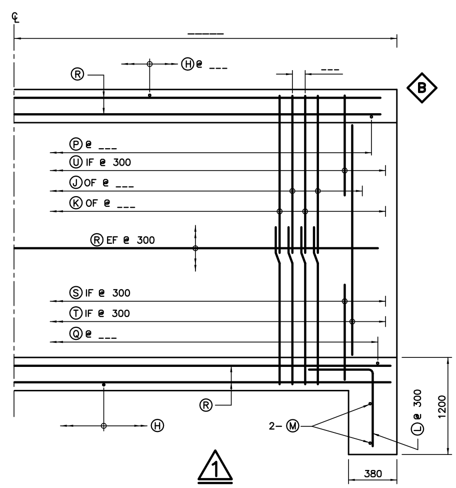






TYPICAL CULVERT SECTION

(APRON DETAILS SHOWN IN 1)
(HEADER WALL DETAILS SHOWN IN B)



MARK	BAR SIZE	C/C	DETAILS	REMARKS
Ⓗ	15M	___	STRAIGHT	TOP OF TOP SLAB & BOTTOM OF BOTTOM SLAB
Ⓙ	___M	___	R=___	J BARS ALTERNATE WITH K BARS
Ⓚ	___M	___	R=___	K BARS ALTERNATE WITH J BARS
Ⓟ **	___M	___	STRAIGHT	BOTTOM OF TOP SLAB STAGGERED
Ⓠ **	___M	___	STRAIGHT	TOP OF BOTTOM SLAB STAGGERED
Ⓡ	15M	300	STRAIGHT	LONGITUDINAL MIN. LAP SPLICE = 500
Ⓢ	15M	300	45° 45° 180 180	HAUNCH
Ⓣ	15M	300	STRAIGHT	INSIDE FACE OF WALLS
Ⓤ	15M	300	45° 45° 180 180	HAUNCH
Ⓛ	15M	300	500 1060	DOWELS TO APRON WALLS
Ⓜ	15M	___	STRAIGHT	APRON WALL
Ⓨ	___M	–	STRAIGHT	HEADER WALL
Ⓩ	15M	300	225 190 230	HEADER WALL

NOTES: – All dimensions shown to centre line of bar
– * represents vertical dimension
– ** c/c spacing given at midspan

QUANTITIES			
ITEM	WALLS & SLABS	RETAINING WALL	TOTAL
VOLUME OF CONCRETE cubic metres	___	___	___

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REFER TO 4.3.1 IN THE CCD MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

OPSD 3941.200 FIGURES IN CONCRETE SITE NUMBER AND DATE LAYOUT
OPSD 803.010 BACKFILL AND COVER FOR CONCRETE CULVERTS

STANDARD DRAWING APRIL 2011	SS114-2
RIGID FRAME BOX CULVERT	

REVISIONS					
		DESCRIPTION			
DESIGN	CHK	CODE CHBDC-00	CL 625-ONT	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No WP No	
NON-RIGID FRAME BOX CULVERT	SHEET

GENERAL NOTES:

1 CLASS OF CONCRETE TO BE 30MPa
2 CLEAR COVER TO REINFORCING STEEL
BOTTOM OF TOP SLAB 40 ± 10
BOTTOM OF BOTTOM SLAB 100 ± 25
REMAINDER 60 ± 20 UNLESS OTHERWISE NOTED
3 REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
4 LEGEND:
IF – DENOTES INSIDE FACE

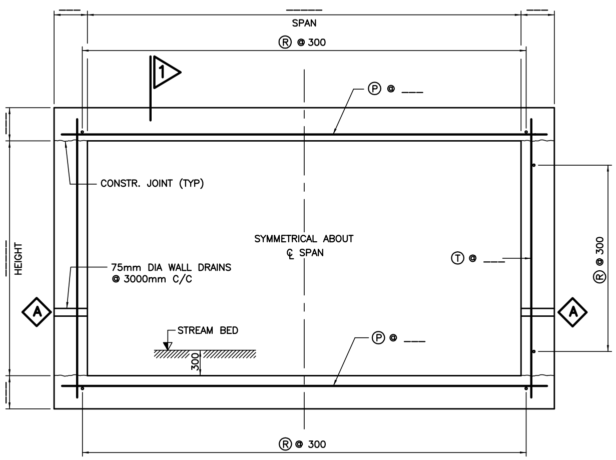
CONSTRUCTION NOTES:

1 BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
2 SUPPORTS FOR REINFORCING STEEL SHALL BE AS PER OPSD–3329.101 AND OPSD–3329.100 ON FORMED SURFACES. ON NON–FORMED SURFACES, CONCRETE BLOCKS (MIN. 20MPa) SHALL BE USED.

MARK	BAR SIZE	C/C	DETAILS	REMARKS
P	20M	___	STRAIGHT	TOP AND BOTTOM SLABS
T	15M	___	STRAIGHT	INSIDE FACE OF WALLS
R	15M	300	STRAIGHT	LONGITUDINAL MIN. LAP SPLICE = 500
L	15M	300	500 / 1080	DOWELS TO APRON WALLS
M	15M	450	STRAIGHT	APRON WALL

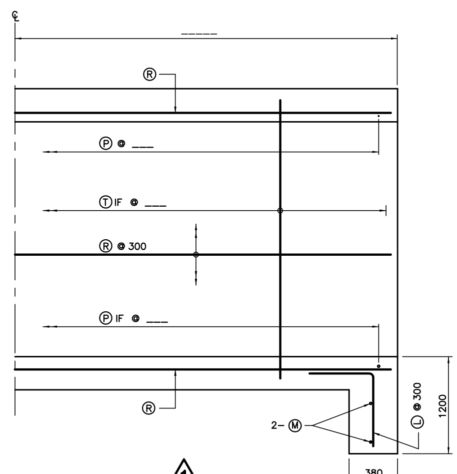
NOTES: – All dimensions shown to centre line of bar
–* represents vertical dimension

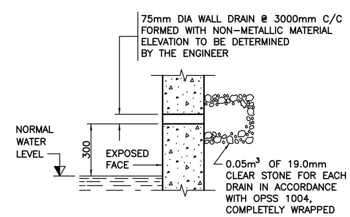
QUANTITIES	
VOLUME OF CONCRETE cubic metres	___



TYPICAL CULVERT SECTION

(APRON NOT SHOWN)





A DETAIL

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

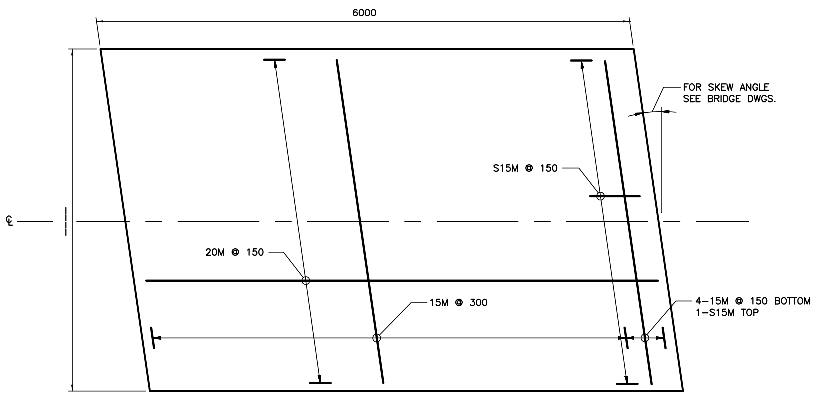
REFER TO 4.3.1 IN THE CCD MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

APPLICABLE STANDARD DRAWINGS

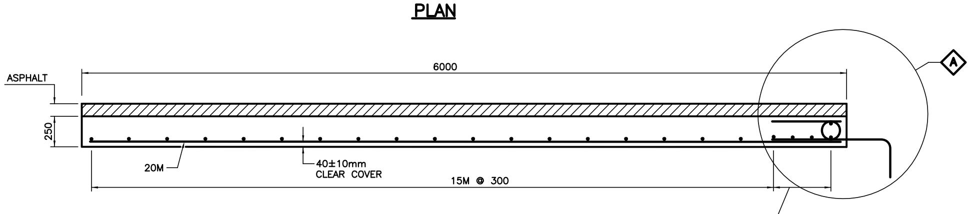
OPSD 803.010 BACKFILL AND COVER FOR CONCRETE CULVERTS

STANDARD DRAWING APRIL 2011	SS114–3
NON–RIGID FRAME BOX CULVERT	

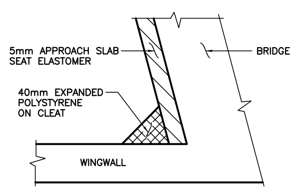
REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE CHBDC–00	CL 625–ONT	DATE	
DRAWN	CHK	SITE		DWG	



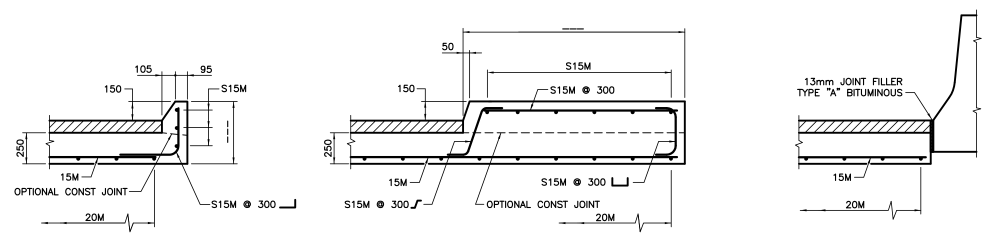
PLAN



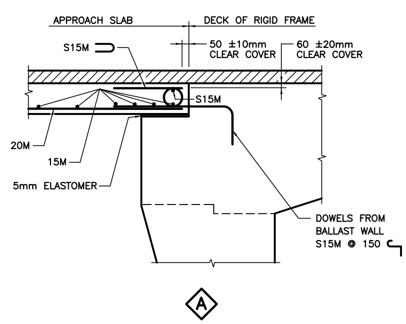
LONGITUDINAL SECTION



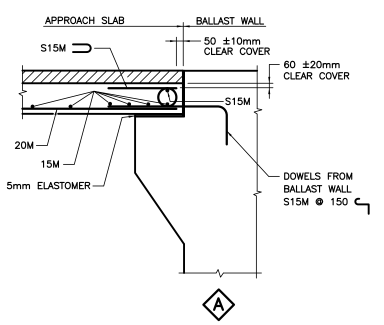
DETAIL AT CLEAT



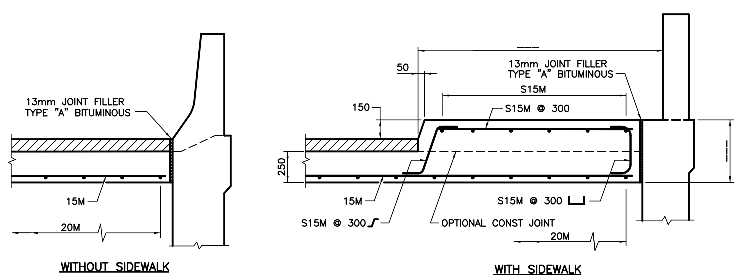
SECTION BEYOND WINGWALL



FOR BRIDGES WITHOUT EXPANSION JOINTS



FOR BRIDGES WITH EXPANSION JOINTS



SECTION AT WINGWALL

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

6000 mm APPROACH SLAB

NOTES:

1. CLEAR COVER TO REINFORCING STEEL 70 ± 20 mm EXCEPT AS NOTED.
2. LAYOUT OF REINFORCING STEEL WILL BE SIMILAR FOR LEFT HAND AND ZERO DEGREE SKEW.
3. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500MPa. REINFORCING STEEL SHALL BE GRADE 400W.
4. WATERPROOFING AT JOINT BETWEEN BRIDGE AND APPROACH SLAB TO BE IN ACCORDANCE WITH OPSD 3370.100.
5. WATERPROOFING FOR BRIDGES WITHOUT EXPANSION JOINTS (RIGID FRAMES AND INTEGRAL ABUTMENTS) TO BE IN ACCORDANCE WITH OPSD 3370.101.
6. BARS MARKED WITH PREFIX S DENOTE STAINLESS STEEL BARS.

APPLICABLE STANDARD DRAWINGS

OPSD 3370.100	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
OPSD 3370.101	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAT 2mm WIDE AND CONSTRUCTION JOINTS

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

STANDARD DRAWING MARCH 2016	SS116–1
6000 mm APPROACH SLAB	

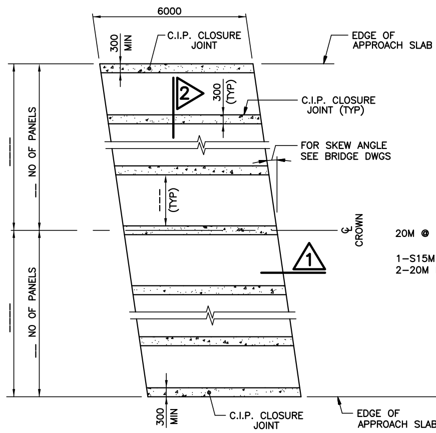
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION	

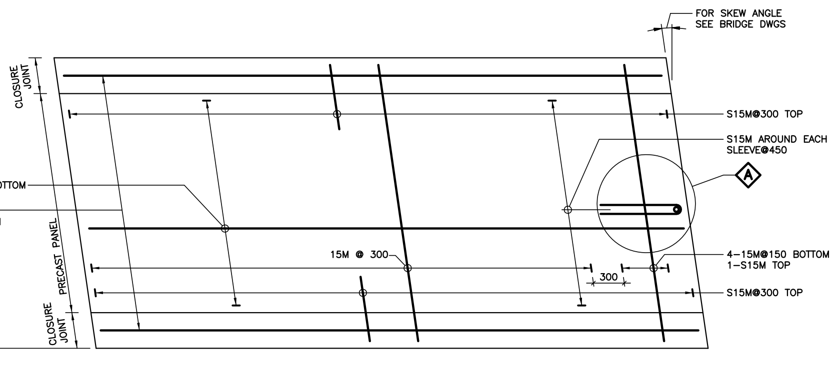
DESIGN	CHK	CODE CHBDC–14	LOAD		DATE
DRAWN	CHK	SITE			DWG

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

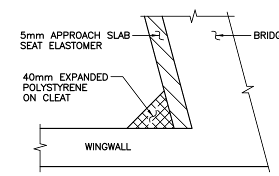
DIST CONT No WP No	SHEET
6000mm PRECAST APPROACH SLAB	



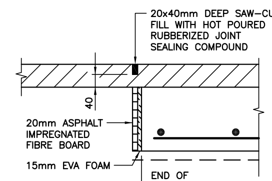
PLAN



TYPICAL PANEL PLAN
(REINFORCING)



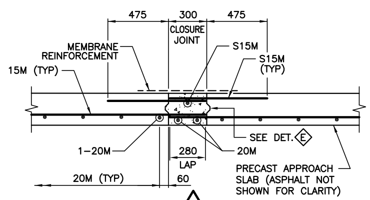
DETAIL AT CLEAT



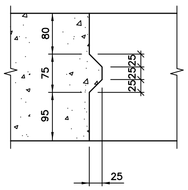
B DETAIL

NOTES:

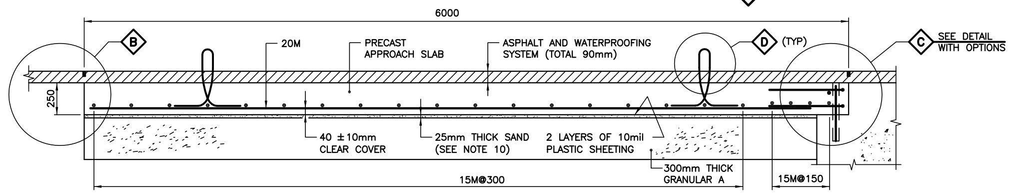
1. CLASS OF CONCRETE TO BE 35 MPa.
2. CLEAR COVER TO REINFORCING STEEL SHALL BE 70±20mm EXCEPT AS NOTED.
3. LAYOUT OF REINFORCING STEEL WILL BE SIMILAR FOR LEFT HAND AND ZERO DEGREE SKEW.
4. STAINLESS STEEL BARS SHALL BE TYPE 316 LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPA. REINFORCING STEEL SHALL BE GRADE 400W.
5. WATERPROOFING AT JOINT BETWEEN BRIDGE AND APPROACH SLAB TO BE IN ACCORDANCE WITH OPSD 3370.100.
6. WATERPROOFING FOR BRIDGES WITHOUT EXPANSION JOINTS (RIGID FRAMES OR INTEGRAL ABUTMENTS) TO BE IN ACCORDANCE WITH OPSD 3370.101.
7. TRANSVERSE REINFORCING BARS SHALL BE OFFSET BETWEEN ADJACENT PRECAST PANELS TO FACILITATE PLACEMENT.
8. ALL LIFTING INSERTS SHALL BE RECESSED AND GALVANISED. CUT ENDS OF LIFTING INSERTS SHALL BE TREATED WITH GALVAN-GUARD OR APPROVED EQUIVALENT PRIOR TO PARGING AND SHALL BE PARGED AFTER ERECTION WITH SIKUDUR AG GROUT OR APPROVED EQUIVALENT.
9. APPROACH SLABS SHALL BE WATERPROOFED AND PAVED. ALL JOINTS SHALL HAVE WATERPROOFING MEMBRANE REINFORCEMENT.
10. 25mm THICK LAYER OF SAND SHALL BE PLACED OVER THE GRANULAR "A" BACKFILL WITH HAND RACKING TO PROVIDE SCREENED EVEN SURFACE FOR APPROACH SLAB INSTALLATION.
11. DETAILS AND LOCATIONS OF LIFTING DEVICE SHALL BE DESIGNED BY THE CONTRACTOR.
12. 50mm DIAMETER CORRUGATED STAINLESS STEEL SLEEVE TO BE MATCH CAST USING COMMON TEMPLATE IN PRECAST ENSURE FIT. THE SLEEVES SHALL BE FILLED WITH 20MPa NON SHRINK GROUT ONCE THE DOWELS ARE PLACED AND CENTRED IN SLEEVES.
13. BARS MARK WITH PREFIX S DENOTE STAINLESS STEEL BARS.



SECTION AT CLOSURE JOINT



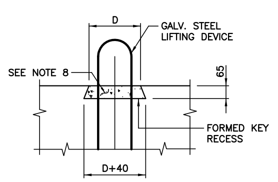
E DETAIL (TYP)



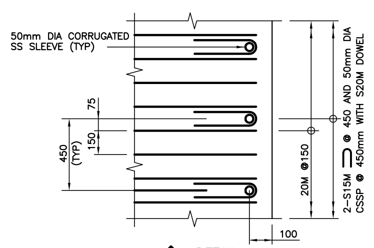
LONGITUDINAL SECTION

NOTES TO DESIGNER:

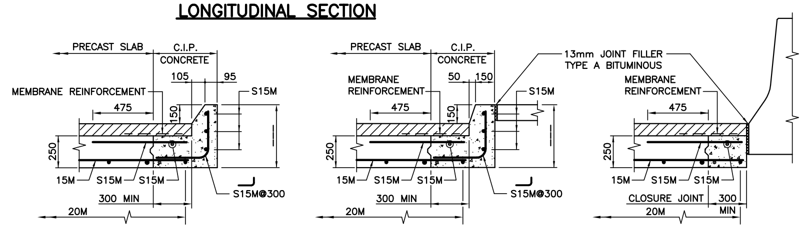
1. THE WIDTH OF PRECAST PANEL SHOULD BE AS CLOSE AS POSSIBLE TO BUT NOT EXCEED 3500 mm.
2. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.



STEEL LIFTING DEVICE



A DETAIL (TYP)

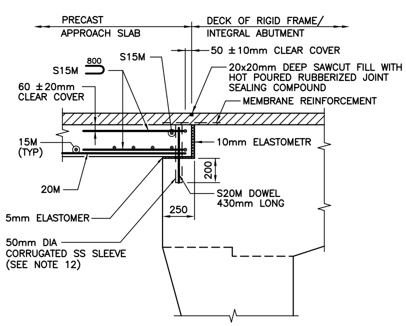


WITHOUT SIDEWALK — WITH SIDEWALK — WITH ROADSIDE BARRIER

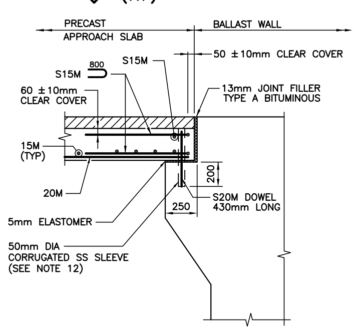
SECTION BEYOND WINGWALL

APPLICABLE STANDARD DRAWINGS

OPSD 3370.100	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
OPSD 3370.101	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAN 2mm WIDE AND CONSTRUCTION JOINTS

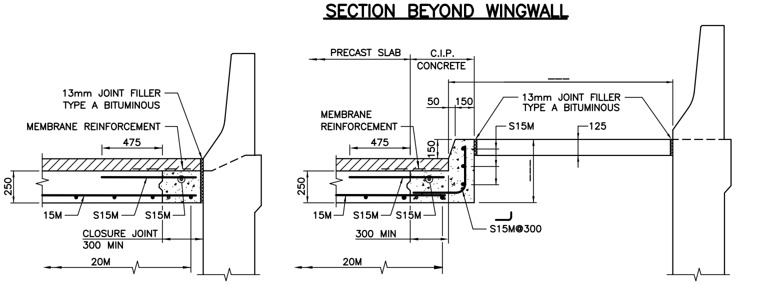


FOR BRIDGES WITHOUT EXPANSION JOINTS



FOR BRIDGES WITH EXPANSION JOINTS

C



WITHOUT SIDEWALK — WITH SIDEWALK

SECTION AT WINGWALL

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS

STANDARD DRAWING JAN 2013	SS116-2
6000mm PRECAST APPROACH SLAB	

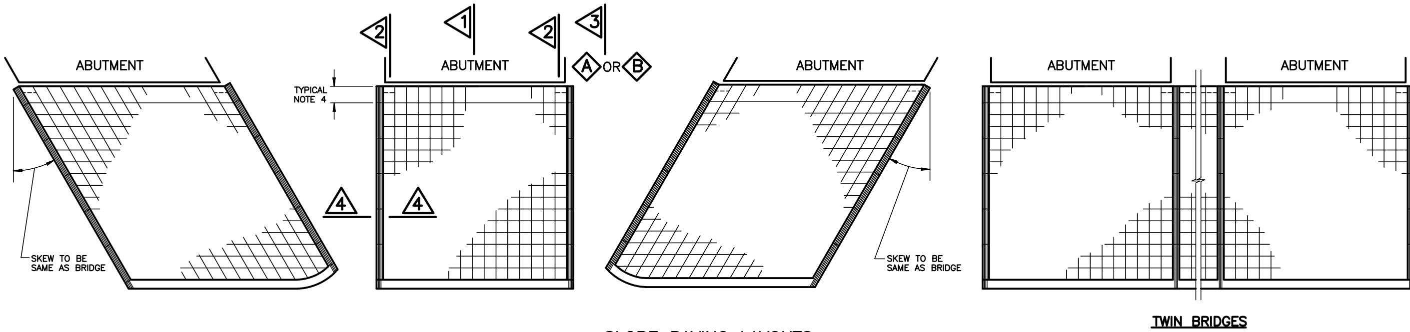
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS				
		DESCRIPTION		
DESIGN	CHK	CODE CHBDC-06	CL	DATE
DRAWN	CHK	SITE		DWG

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

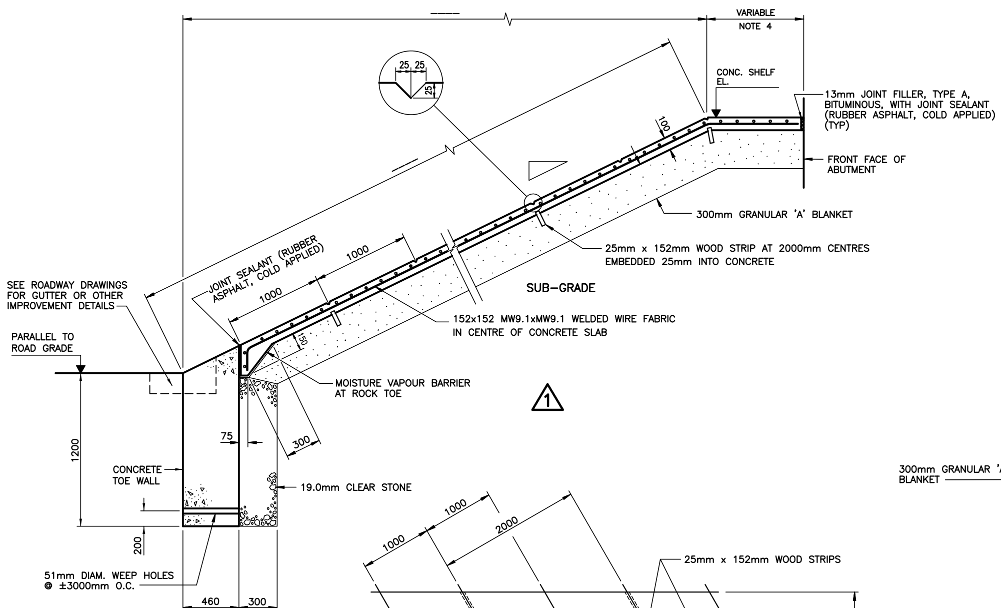
DIST	
CONT	
WP	SHEET
DETAILS OF CONCRETE SLOPE PAVING	

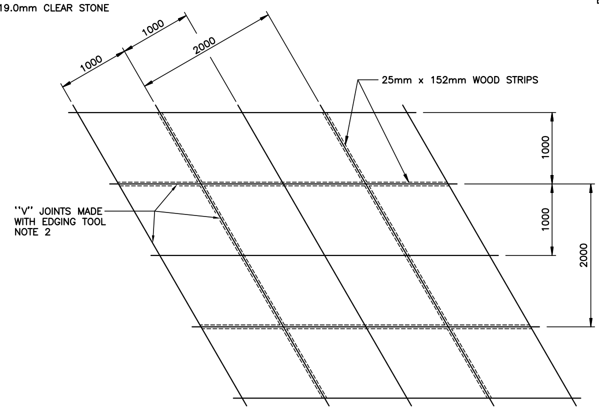


SLOPE PAVING LAYOUTS

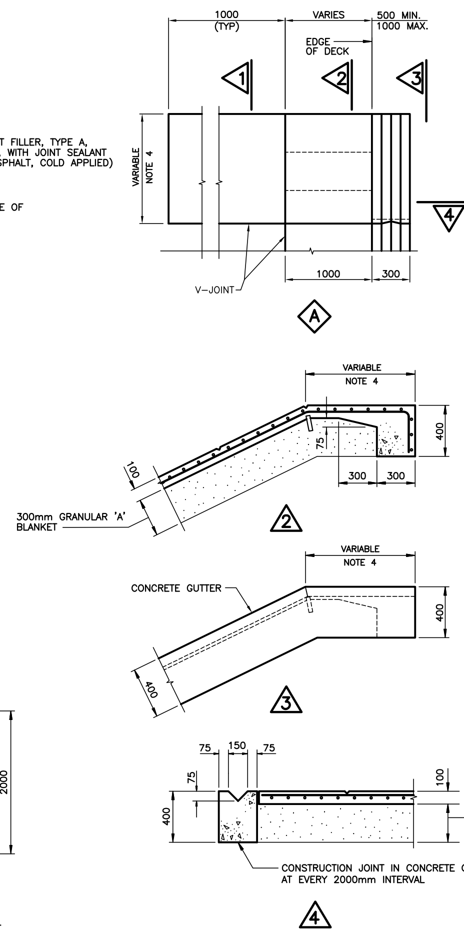
NOTES:

1. SECTIONS AND DETAILS TYPICAL FOR ALL LAYOUTS.
2. FOR BRIDGES WITH SKEW EXCEEDING 45°, "V" GROOVES SHALL BE PROVIDED AT 2000mm O.C. OVER WOOD FRAME STRIPS ONLY.
3. ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
4. THIS DIMENSION VARIES TO MAINTAIN SLOPE OF ROADWAY APPROACH CUT THROUGH THE WIDTH OF THE BRIDGE.

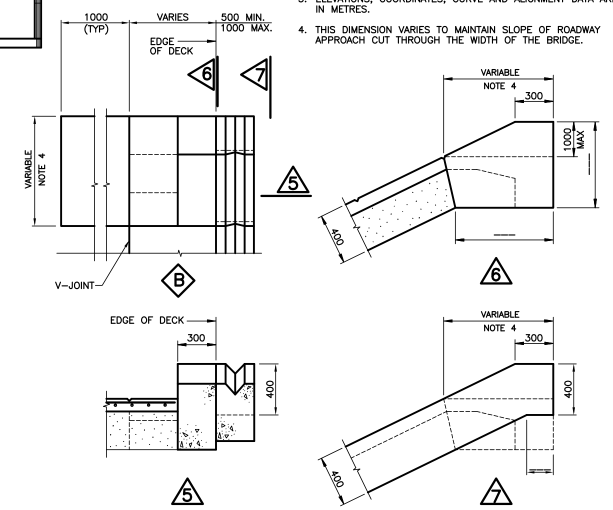




WOOD FRAME AND "V" JOINT LAYOUT



DETAIL WITHOUT RETAINING WALL



OPTIONAL DETAIL WITH RETAINING WALL

NOTES TO DESIGNER:

1. FOR INSPECTION PURPOSES IT IS RECOMMENDED THAT THE MINIMUM SHELF WIDTH SHALL BE 1000 mm AND THE MINIMUM VERTICAL HEIGHT FROM THE UNDERSIDE OF THE SUPERSTRUCTURE TO THE CONCRETE SHELF ELEVATION BE PROVIDED AS FOLLOWS:
   - SLAB AND GIRDER BRIDGES 1.0 m
   - OTHER BRIDGES 1.5 m
2. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THE CONTRACT DRAWINGS.
3. WHEN THE SHELF ELEVATION IS NOT THE SAME AS THE SIDE SLOPE APPROACH BERM ELEVATIONS, OR IF THERE IS NO BERM AND THERE IS UNSUPPORTED SOIL, THE OPTIONAL RETAINING WALL DETAIL SHALL BE CONSIDERED. NON-APPLICABLE DETAILS SHALL BE CROSSED OUT OR DELETED.

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

STANDARD DRAWING DECEMBER 2003	SS116-10
DETAILS OF CONCRETE SLOPE PAVING	

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

REVISIONS — DESCRIPTION

DESIGN	CHK	CODE CHBDC-00	LOAD	DATE	
DRAWN	CHK	SITE		DWG	

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

	JOINT INSTALLATION		WALL INSTALLATION		OPEN TO TRAFFIC	
	DATE	TEMP C°	DATE	TEMP C°	DATE	TEMP C°
SURVEYOR'S INITIALS ▶		H		H		H
		L		L		L
SURVEYOR'S INITIALS ▶		H		H		H
		L		L		L
SURVEYOR'S INITIALS ▶		H		H		H
		L		L		L
AVERAGE TEMPERATURE						

LOCATION	POINT	DIM'Y'mm	DIM'X'mm	DIM'Y'mm	DIM'X'mm	DIM'Y'mm	REMARKS

DIMENSION 'X' & 'Y' TABLE FOR EXPANSION JOINT GAPS

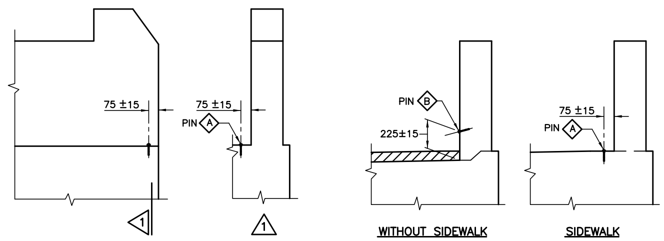
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

SHEET

AS CONSTRUCTED ELEV. & DIM'N



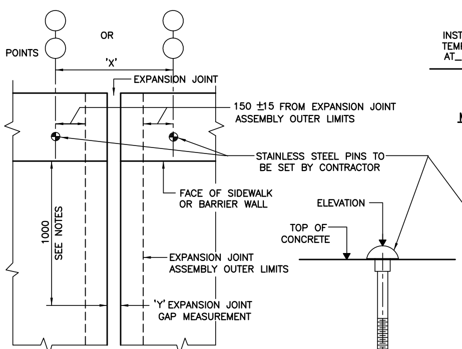
LOCATION AT END OF WINGWALLS

TYPICAL CROSS–SECTIONS

LOCATION OF PINS ON PARAPET WALL

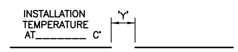
NOTES:

1. EXPANSION JOINT GAP DIMENSION 'Y' AND INSTALLATION TEMPERATURE ARE TO BE RECORDED AT THE TIME OF INSTALLATION OF JOINT.
2. HIGH AND LOW TEMPERATURES, DIMENSIONS 'X' AND 'Y' AND TEMPERATURES FOR THE PRECEDING 2 DAYS ARE TO BE RECORDED AT THE TIME PINS ARE INSTALLED IN CURB OR BARRIER/PARAPET WALL. PINS SHALL BE INSTALLED BEFORE CONCRETE HAS SET.
3. AS CONSTRUCTED ELEVATIONS (TIED TO PERMANENT REF GBM) AND DIMENSIONS AT EXPANSION JOINT GAPS TO BE TAKEN BY OWNER AND RECORDED ON THIS DRAWING IMMEDIATELY BEFORE OPENING BRIDGE TO TRAFFIC.
4. FURTHER READINGS TO BE TAKEN AS REQUESTED.
5. JOINT GAP 'Y' TO BE MEASURED AT A POINT 1000 mm FROM SIDEWALK FACE OR BARRIER/PARAPET WALL FACE AT DECK LEVEL.
6. STAINLESS STEEL PINS TO BE M10 x 80mm LONG CARRIAGE BOLT TYPE SUPPLIED BY CONTRACTOR.
7. PINS TO BE PLACED AT EACH SIDE OF EXPANSION JOINTS, AT CENTRE LINE OF SPAN, AT CENTRE LINE OF SUPPORTS AND AT END OF WINGWALLS ALONG EACH SIDE OF BRIDGE.

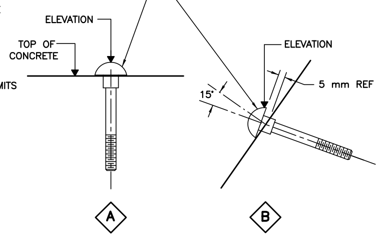


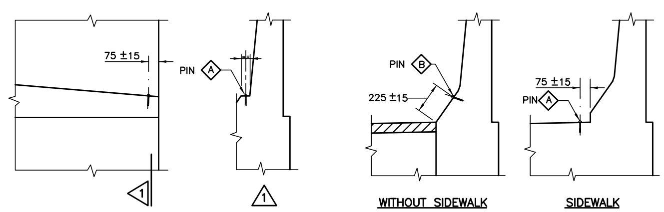
SCHEMATIC PLAN

DETAILS AT EXPANSION JOINT SHOWING LOCATION OF PIN RELATIVE TO BRIDGE EXPANSION JOINT



EXPANSION JOINT GAP MEASUREMENT AT INSTALLATION

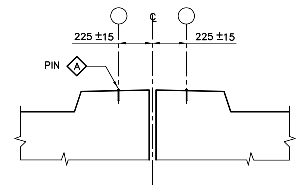




LOCATION AT END OF WINGWALLS

TYPICAL CROSS–SECTIONS

LOCATION OF PINS ON BARRIER WALL



LOCATION OF PINS ON MEDIAN

POINT	LOCATIONS ⊕	ELEV m *	ELEV m	MOVEMENT mm	ELEV m	MOVEMENT mm	ELEV m	MOVEMENT mm	ELEV m	MOVEMENT mm	◀ SURVEYOR INITIAL & DATE REMARKS
		SIDE									
1A	END W/WALL										
2A	FACE /WALL										
3A	DECK AT ABUT										
4A											

POINT	LOCATIONS ⊕	ELEV m *	ELEV m	MOVEMENT mm	ELEV m	MOVEMENT mm	ELEV m	MOVEMENT mm	ELEV m	MOVEMENT mm	◀ SURVEYOR INITIAL & DATE REMARKS
		SIDE									
1	END W/WALL										
2	FACE /WALL										
3	DECK AT ABUT										
4											

* TAKEN IMMEDIATELY BEFORE OPENING BRIDGE TO TRAFFIC

LOCATION & ELEVATION TABLE

SITE No

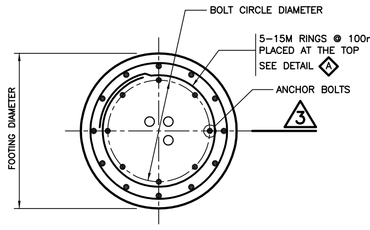
STANDARD DRAWING JUNE 2002 | SS116–40

AS CONSTRUCTED ELEV. & DIM'N

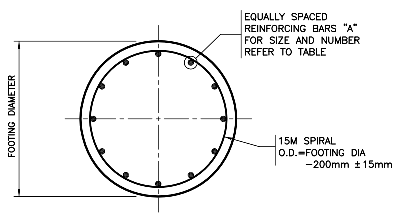
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			DESCRIPTION		
DESIGN	CHK	CODE		LOAD	DATE
DRAWN	CHK	SITE			DWG

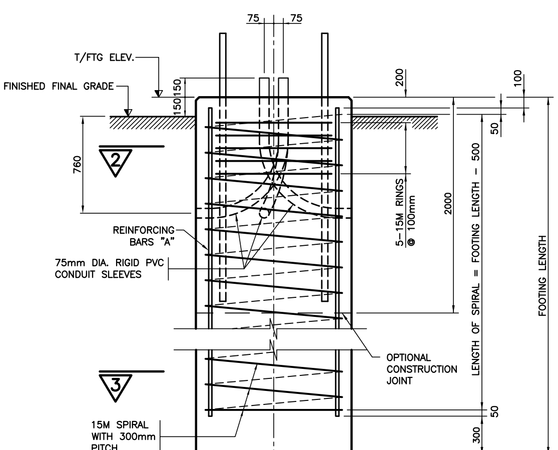
MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05



2
N.T.S.



3
N.T.S.



1
N.T.S.

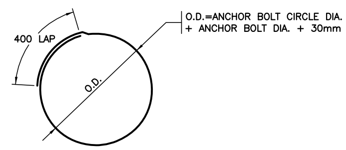
QUANTITIES

TOTAL No. OF POLES THIS SHEET =	

FOOTING DATA

POLE No.	LOCATION	POLE HEIGHT (m)	T/FTG ELEVATION (m)	FOOTING DIAMETER (m)	FOOTING LENGTH (m)	REINFORCING BARS "A"			SPIRAL	
						SIZE	No. REQ'D	LENGTH (m)	LENGTH (m)	DIA.* (m)

NOTE * – INDICATED VALUE IS OUTSIDE DIAMETER.



A 15M RINGS DETAIL
N.T.S.

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT
WP

SHEET

HIGH MAST LIGHTING POLE FOOTING
GROUND MOUNTED

NOTES:

1. CLASS OF CONCRETE SHALL BE 30 MPa.
2. CLEAR COVER TO REINFORCING STEEL SHALL BE 100±25mm.
3. REINFORCING STEEL SHALL BE GRADE 400W.
4. THE REINFORCING STEEL ASSEMBLY SHALL BE CAREFULLY FABRICATED TO ENSURE THE ANCHORAGE ASSEMBLY WIL FIT.
5. EACH ANCHORAGE ASSEMBLY SHALL BE PROVIDED WITH A TEMPLATE.
6. ANCHORAGE ASSEMBLY SHALL BE INSTALLED VERTICALLY. NO ADJUSTMENTS SHALL BE ALLOWED AFTER CONCRETE IS PLACED IN FOOTING.
7. FOR FINISHED GRADE ELEVATION, REFER TO GRADING DRAWINGS.
8. IF SOIL CONDITIONS ENCOUNTERED IN FIELD ARE DIFFERENT FROM THOSE SHOWN IN FOUNDATION INVESTIGATION AND DESIGN REPORT, WORK SHALL BE HALTED AND THE CONTRACTOR ADMINISTRATOR NOTIFIED IMMEDIATELY.

NOTES TO DESIGNER:

1. UNFACTORED LOADS PROVIDED IN TABLE BELOW ARE BASED ON HOURLY MEAN WIND PRESSURE q = 595 Pa.

POLE HEIGHT (m)	MINIMUM FOOTING DIAMETER (m)	REINFORCING BARS "A"	UNFACTORED LOADS AT BASE OF HMLP	
		MAX. SIZE	MOMENT (kN–m)	SHEAR (kN)
25	1.22	30M	380	29
30	1.37	30M	570	38
35	1.37	30M	815	50
40	1.52	35M	895	48
45	1.52	35M	1155	56

2. THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

APPLICABLE STANDARD DRAWINGS

OPSD 2218.010 HIGH MAST LIGHTING POLE ANCHORAGE ASSEMBLY
OPSD 2456.011 HIGH MAST LIGHTING POLE ANCHORAGE ASSEMBLY DETAILS

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING
APRIL 2011

SS116–50

HIGH MAST LIGHTING POLE FOOTING
GROUND MOUNTED

REVISIONS
DESCRIPTION

DESIGN	CHK	CODE CHBDC–00	LOAD	DATE
DRAWN	CHK	SITE		DWG

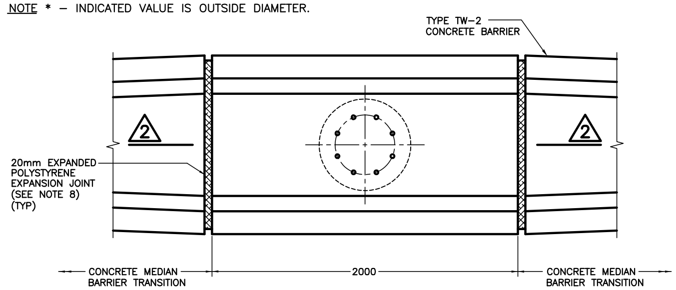
QUANTITIES

TOTAL No. OF POLES THIS SHEET =	

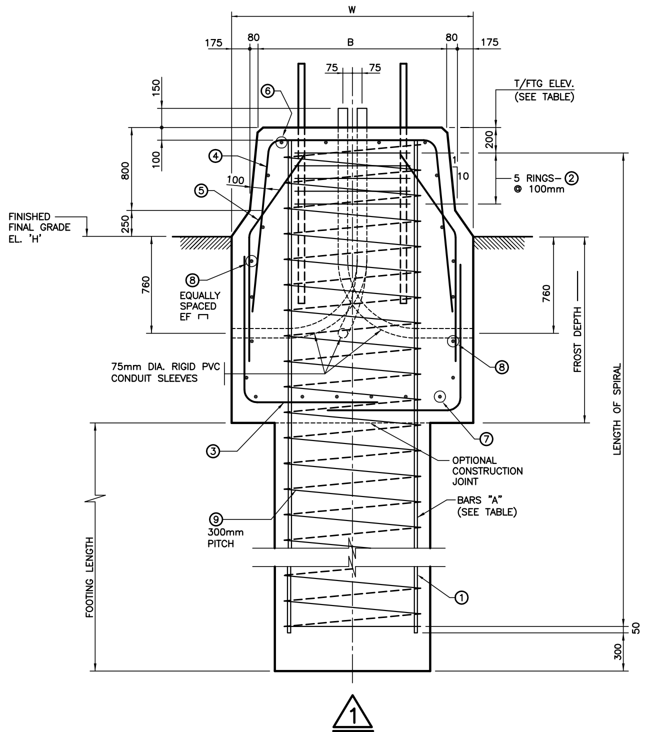
FOOTING DATA

POLE No.	LOCATION	POLE HEIGHT (m)	T/FTG ELEVATION (m)	FOOTING DIAMETER (m)	FOOTING LENGTH (m)	REINFORCING BARS "A" SIZE	REINFORCING BARS "A" No. REQ'D	REINFORCING BARS "A" LENGTH (m)	SPIRAL LENGTH (m)	SPIRAL DIA.* (m)	BARRIER DIMENSIONS B (mm)	BARRIER DIMENSIONS EL. "H" (m)	BARRIER DIMENSIONS W (mm)

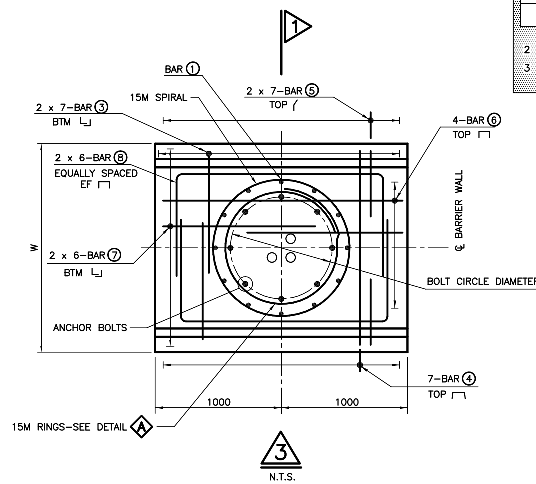
NOTE * – INDICATED VALUE IS OUTSIDE DIAMETER.



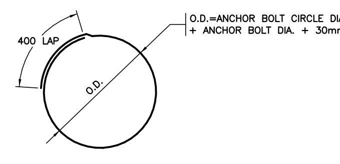
PLAN



1 N.T.S.

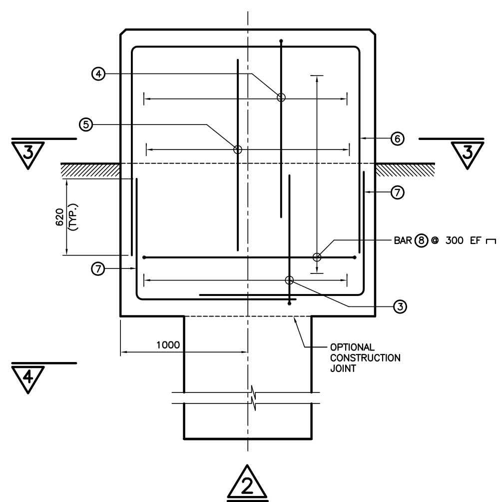


3 N.T.S.

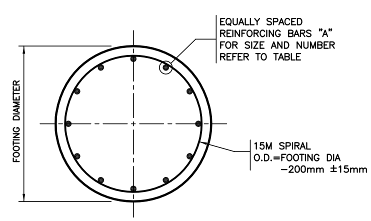


A 15M RINGS DETAIL

N.T.S.



2 N.T.S.



4 N.T.S.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT WP

HIGH MAST LIGHTING POLE FOOTING MEDIAN TALL WALL MOUNTED (SYMMETRICAL)

SHEET

NOTES TO DESIGNER

1 UNFACTORED LOADS PROVIDED IN TABLE BELOW ARE BASED ON HOURLY MEAN WIND PRESSURE q = 595 Pa.

POLE HEIGHT (m)	FOOTING DIAMETER (m)	REINFORCING BARS "A" MAX. SIZE	B min. (mm)	UNFACTORED LOADS AT BASE OF HMLP MOMENT (kN–m)	UNFACTORED LOADS AT BASE OF HMLP SHEAR (kN)
25	1.22	30M	1350	380	29
30	1.37	30M	1500	570	38
35	1.37	30M	1500	815	50
40	1.52	35M	1650	895	48
45	1.52	35M	1650	1155	56

2 INDICATE FROST DEPTH.

3 THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

NOTES:

1 CLASS OF CONCRETE SHALL BE 30 MPa.
2 CLEAR COVER TO REINFORCING STEEL SHALL BE 100±25mm.
3 REINFORCING STEEL SHALL BE GRADE 400W.
4 THE REINFORCING STEEL ASSEMBLY SHALL BE CAREFULLY FABRICATED TO ENSURE THE ANCHORAGE ASSEMBLY WILL FIT.
5 EACH ANCHORAGE ASSEMBLY SHALL BE PROVIDED WITH A TEMPLATE.
6 ANCHORAGE ASSEMBLY SHALL BE INSTALLED VERTICALLY. NO ADJUSTMENTS SHALL BE ALLOWED AFTER CONCRETE IS PLACED IN FOOTING.
7 FOR FINISHED GRADE ELEVATION, REFER TO GRADING DRAWINGS.
8 EXPANDED POLYESTYRENE IN EXPANSION JOINT SHALL CONFORM TO CGSB 51.20 AND BE HELD IN PLACE WITH LIGHT GALVANIZED NAILS.
9 IF SOIL CONDITIONS ENCOUNTERED IN FIELD ARE DIFFERENT FROM THOSE SHOWN IN FOUNDATION INVESTIGATION AND DESIGN REPORT, WORK SHALL BE HALTED AND THE CONTRACT ADMINISTRATOR NOTIFIED IMMEDIATELY.

BAR MARK	SIZE	SHAPE
1	BARS 'A'	STRAIGHT
2	15M	
3	15M	
4	15M	
5	15M	
6	15M	
7	15M	
8	15M	
9	15M	SPIRAL

APPLICABLE STANDARD DRAWINGS

OPSD 2218.010 HIGH MAST LIGHTING POLE ANCHORAGE ASSEMBLY
OPSD 2456.011 HIGH MAST LIGHTING POLE ANCHORAGE ASSEMBLY DETAILS
OPSD 911.380 GUIDE RAIL SYSTEM, CONCRETE BARRIER PERMANENT TRANSITION INSTALLATION AT PIERS AND POLES

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

STANDARD DRAWING JAN 2013 | SS116–51

HIGH MAST LIGHTING POLE FOOTING MEDIAN TALL WALL MOUNTED (SYMMETRICAL)

REVISIONS | DESCRIPTION

DESIGN	CHK	CODE CHBDC-00	LOAD	DATE
DRAWN	CHK	SITE		DWG

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

QUANTITIES

TOTAL No. OF POLES THIS SHEET =	

FOOTING DATA

POLE No.	LOCATION	POLE HEIGHT (m)	T/FTG ELEVATION (m)	FOOTING DIAMETER (m)	FOOTING LENGTH (m)	REINFORCING BARS "A" SIZE	REINFORCING BARS "A" No. REQ'D	REINFORCING BARS "A" LENGTH (m)	SPIRAL LENGTH (m)	SPIRAL DIA.* (m)	BARRIER DIMENSIONS B (mm)	EL. "H" (m)	EL. "L" (m)	W (mm)	X (mm)	Y (mm)	Z (mm)

NOTE * – INDICATED VALUE IS OUTSIDE DIAMETER.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

HIGH MAST LIGHTING POLE FOOTING MEDIAN TALL WALL MOUNTED (ASYMMETRICAL)

SHEET

NOTES TO DESIGNER

1 UNFACTORED LOADS PROVIDED IN TABLE BELOW ARE BASED ON HOURLY MEAN WIND PRESSURE q = 595 Pa.

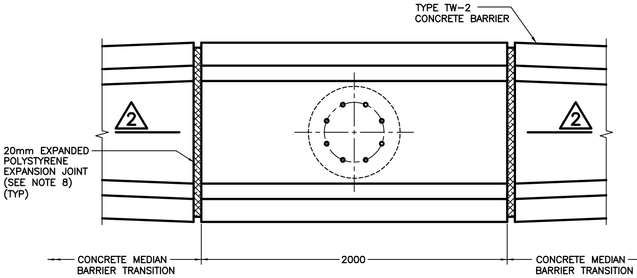
POLE HEIGHT (m)	FOOTING DIAMETER (m)	REINFORCING BARS "A" MAX. SIZE	B min. (mm)	UNFACTORED LOADS AT BASE OF HMLP MOMENT (kN–m)	SHEAR (kN)
25	1.22	30M	1350	380	29
30	1.37	30M	1500	570	38
35	1.37	30M	1500	815	50
40	1.52	35M	1650	895	48
45	1.52	35M	1650	1155	56

2 INDICATE FROST DEPTH.

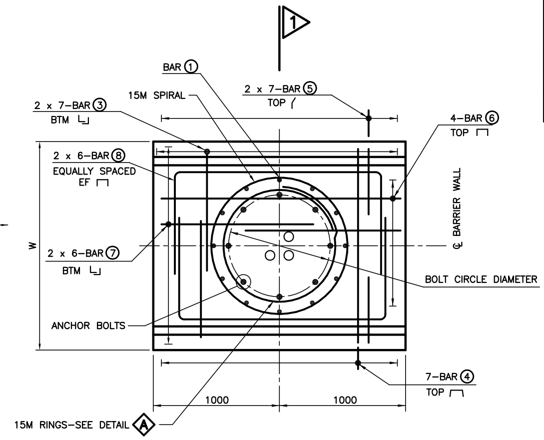
3 THE "NOTES TO DESIGNER" SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING OF THE CONTRACT.

NOTES:

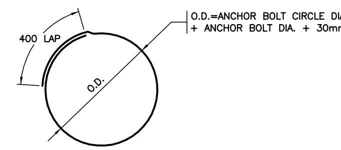
1 CLASS OF CONCRETE SHALL BE 30 MPa.
2 CLEAR COVER TO REINFORCING STEEL SHALL BE 100±25mm.
3 REINFORCING STEEL SHALL BE GRADE 400W.
4 THE REINFORCING STEEL ASSEMBLY SHALL BE CAREFULLY FABRICATED TO ENSURE THE ANCHORAGE ASSEMBLY WILL FIT.
5 EACH ANCHORAGE ASSEMBLY SHALL BE PROVIDED WITH A TEMPLATE.
6 ANCHORAGE ASSEMBLY SHALL BE INSTALLED VERTICALLY. NO ADJUSTMENTS SHALL BE ALLOWED AFTER CONCRETE IS PLACED IN FOOTING.
7 FOR FINISHED GRADE ELEVATION, REFER TO GRADING DRAWINGS.
8 EXPANDED POLYESTYRENE IN EXPANSION JOINT SHALL CONFORM TO CGSB 51.20 AND BE HELD IN PLACE WITH LIGHTGALVANIZED NAILS.
9 IF SOIL CONDITIONS ENCOUNTERED IN FIELD ARE DIFFERENT FROM THOSE SHOWN IN FOUNDATION INVESTIGATION AND DESIGN REPORT, WORK SHALL BE HALTED AND THE CONTRACT ADMINISTRATOR NOTIFIED IMMEDIATELY.



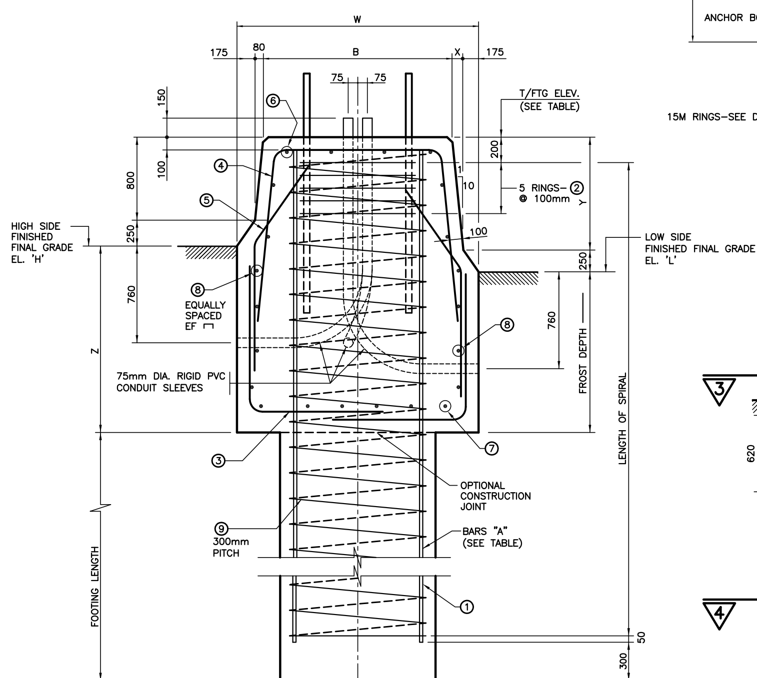
PLAN



3
N.T.S.



A 15M RINGS DETAIL
N.T.S.



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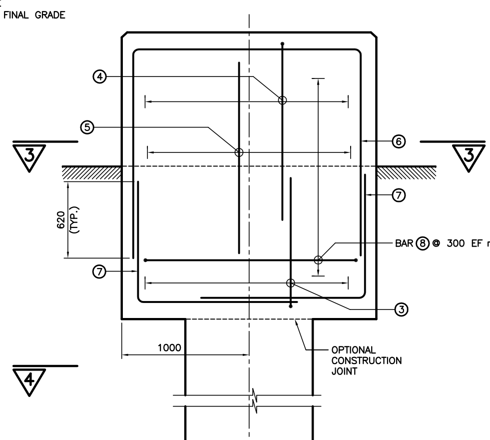

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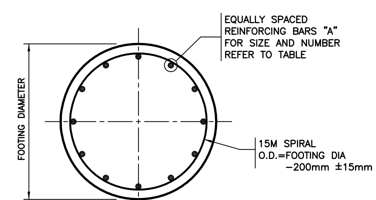
N.T.S.



4
N.T.S.

BAR MARK	SIZE	SHAPE
1	BARS 'A'	STRAIGHT
2	15M	
3	15M	
4	15M	
5	15M	
6	15M	
7	15M	
8	15M	
9	15M	SPIRAL

APPLICABLE STANDARD DRAWINGS

OPSD 2218.010	HIGH MAST LIGHTING POLE ANCHORAGE ASSEMBLY
OPSD 2456.011	HIGH MAST LIGHTING POLE ANCHORAGE ASSEMBLY DETAILS
OPSD 911.380	GUIDE RAIL SYSTEM, CONCRETE BARRIER PERMANENT TRANSITION INSTALLATION AT PIERS AND POLES

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.

DRAWING NOT TO BE SCALED 100mm ON ORIGINAL DRAWING

STANDARD DRAWING JAN 2013 | SS116–52

HIGH MAST LIGHTING POLE FOOTING MEDIAN TALL WALL MOUNTED (ASYMMETRICAL)

REVISIONS		DESCRIPTION		
DESIGN	CHK	CODE CHBDC–00	LOAD	DATE
DRAWN	CHK	SITE		DWG

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Ministry of Transportation
Ontario
2016

Ontario